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Reduction in Page Size

BEGINNING with the new year, the Engineering Record's page size will be reduced to 9 x 12 in., the so-called standard for engineering publications. The publishers have decided to make the change in order to effect necessary economies and give the readers the paper in handier form. The smaller size will be more economical in paper and mailing. Moreover, since the McGraw Publishing Company issues four technical magazines of standard size—*Electrical World, Electric Railway Journal, Metallurgical & Chemical Engineering* and *Electrical Merchandising*—the reduction of the Engineering Record to the same dimensions will permit of printing-office standardization that will result in still further savings. These economies are essential in order that, in the face of greatly increased publishing costs, the standards which the Engineering Record has set may be maintained. The change is made, too, in full confidence that it will meet with the approval of the readers. Careful inquiry has indicated that a large majority of them will welcome the reduction. Ease in handling, convenience in filing, possibility of using standard shelving, all favor the 9 x 12-in. page. The publishers have long appreciated that these advantages inhered in the smaller size. Two of their other publications have for more than twenty years appeared in the smaller page form, but various considerations, not necessary to repeat here, made a change in the Engineering Record's page inadvisable until the present time. Outwardly, the Engineering Record will look slightly different. Inwardly, it will be the same Engineering Record—timely, comprehensive, thorough, unique in its presentation, vigorous in its editorials, having always the courage of its convictions. In other words, it will be the same Engineering Record in spirit, in aim, in policy—and in a more convenient form.

Electrolytic Sewage Treatment

SEWAGE treatment by electricity has long had an appeal to the scientific as well as to the engineering mind. But mere attractiveness does not satisfy in the present scientific times. Results and comparisons with other forms of treatment are demanded. The experiments on the electrolytic-lime treatment at Decatur, Ill., were excellent, but they did not go far enough. The skeptic wants to know what lime alone would have done, because Prof. Earle B. Phelps, during the Elmhurst controversy, held that lime alone would do practically the same work mechanically as lime and electricity. Now comes the climax at Decatur. Prof. Edward Bartow details it on page 596. The city ordered that the plant run a comparative test, and this was only well started when the company objected and ordered the plant dismantled. This is bad business procedure. If the company is more than a stock-jobbing proposition it must come out in the open and let the engineering profession know what goes on inside the electrolytic box. It must run comparative tests. It must tell how thin the plates become in a given time. The true experimenter tries, within reason and sometimes without reason, everything he can think of or that anyone suggests. When this is done with the electrolytic-lime treatment, and not until then, will the process have standing before the engineering profession.

The Right Type of Road

SALESMANSHIP in many lines of industry and engineering has been put upon fundamentally sound grounds. In the machine-tool field, for example, the time is long since past when a manufacturer would palm off on a customer machinery not adapted to his needs. Now the manufacturer investigates the prospective customer's requirements and—often as a result of careful engineering analysis—supplies him with equipment particularly adapted to the conditions which the customer must meet. Unfortunately, this wave of efficient salesmanship has not swept away all of the unsound promotion and selling practices in the highway-materials field. Reference is not made here to the criminal methods of road promotion which to some extent still persist. Of course, these underhand methods of selling very frequently are joined with the error here condemned—the selling of road materials for conditions to which they are not adapted. Nevertheless, even when the selling is not tainted by graft, this fault can be found with much highway promotion work. The results are patent on every side. Materials laid under conditions to which they are not suited are going to pieces and building up heavy financial burdens in the way of maintenance and reconstruction costs. And yet the promoters will not learn the lesson. They are proceeding on the theory, profitable temporarily perhaps, of "going while the going is good." Their policy is shortsighted. Their materials are being so soundly condemned that it will be many years before they recover from the effects of the criticism. Some interests, fortunately, are adopting the wiser course. Not only are they confining their promotion work to situations where the use of their material is entirely proper, but by careful inspection and insistence upon high standards are insuring that their products will render the best service of which they are capable. Such promotion methods must become universal, not for the sake of the material manufacturers, though they would be better served thereby, but in the interests of the public at large. The Engineering Record cares not if some of the companies ruin their businesses entirely. In fact, it believes that for the good of engineering and of the public it would be well if these shortsighted companies would be out of the field. This journal cares much, however, for the future of the road-building art, for the public attitude toward highways and highway officials, and for the efficient expenditure of the taxpayer's money. These interests demand that road-promotion work be put on an honest, on an engineering basis.

Quality of Concrete

STRIKING evidence of the danger to concrete structures from improper mixing and placing is afforded by the report of C. B. McCullough on the failure of the highway bridge at Independence, Ore., an abstract of which is printed on page 597 of this issue. Evidence of rank carelessness and of lack of adequate inspection is presented. The lesson to engineers is the old one, which in spite of continued reiteration appears to require new emphasis, that concrete is of great permanence and reliable strength only when the composite materials are properly placed. Perhaps the most potent force that can be brought to bear on contractors to insure the production of the best possible concrete with the materials available is that of economic interest combined with tests of the concrete actually going into the structure, as advocated by C. M. Chapman in the Engineering Record of July 8, page 49. He proposes that, instead of specifying the requirements for the materials used, which might exclude cheap available aggregates, the concrete actually placed in the structure be required to show a given minimum compressive strength when field samples are tested at a given age. Editorial comment in that issue pointed out the great influence that such a form of specification would have in improving the quality of concrete. With adequate inspection to make certain that this quality of concrete really gets into the forms, the profession would be insured against such failures as that just reported.

Filter-Patent Claims Invalid

A DECISION of considerable interest to waterworks men was rendered last month by Judge Hook of the U. S. Circuit Court of Appeals, Eighth District. By it two important patent claims of Ira H. Jewell—for the central control of operating valves and for the use of a screen between the gravel and sand layers of mechanical filters—have been declared invalid. The decision was rendered in the case of Jewell against the City of Minneapolis, which, it will be recalled, completed and put into operation its large mechanical filtration plant in January, 1913. In regard to the central control feature, the Court pointed out that this principle has been far too common in other fields to admit of the validity of a patent claim. It has been employed extensively, for example, in hydraulic systems for closing bulkheads on ships and for operating hatches, ports, valves, etc. Speaking of the screen feature of the Jewell claims, the Court expressed the view that this feature did not "rise to the dignity of invention." The case is important, not merely because it frees Minneapolis from further litigation, but because it establishes a precedent applicable to a vast number of cities and towns in which mechanical filtration plants have been installed. The Jewell damage claims, according to a recent statement in the Minneapolis press, amounted to approximately $100,000, and the cost of litigation, according to Charles D. Gould, city attorney, was $28,000. By the recent decision, therefore, the city saved $72,000. It would appear from the Minneapolis case that the patent claims for central control and for holding-down screens have been set at rest. Certainly the case is ended for the particular circuit.

Foundation of Journalistic Influence

ELSEWHERE in this issue is printed a letter criticising the Engineering Record for publishing a communication claiming that a concrete road in Wayne County, Mich., had worn out. The letter criticised was written by an official of a paving company. Broadly stated, the Engineering Record conceives it to be the duty of a technical journal to open its columns, when claim of an error has been made, to any man of standing who believes he has controverting evidence—provided the prospective contributor does not conceal his identity and prevent the readers from weighing properly the value of the evidence presented.

The Engineering Record stated in an editorial in its issue of Oct. 7 that "No concrete roads in Wayne County have as yet worn out." A correspondent presented controverting evidence. Having taken advantage of the occasion to plead for his own special material, he presented the alleged controverting evidence, however, and pleaded his own product in an open and above-board manner. He signed himself as an official of an asphalt paving company. That is full notice that he is a partisan and that the partisan leaning must be taken into consideration in weighing the communication.

To have refused admission to the columns of the Engineering Record of the communication, and to adopt a general policy of excluding controverting evidence, would be to rob the Engineering Record of its reputation for fairness. If an error is made, the readers have a right to know that controverting evidence has been offered. To suppress it is to violate the covenant to tell the truth, which this journal makes with each of its subscribers. From the reader's standpoint therefore the publication of the letter was a matter not of choice but of necessity.

From the advertiser's standpoint, the publication was equally necessary. The value of the Engineering Record as an advertising medium rests upon its standing in its field, and that standing is predicated upon a well-won reputation for fairness, accuracy and fearlessness. Take these qualities from the Engineering Record and its influence would soon wane. With its disappearing influence would go its value as an advertising medium. From even the commercial point of view, therefore, the publication of Mr. Pierce's letter was sound policy—policy calculated in the long run to be a help rather than a detriment to the interests which Mr. Cameron represents.

There is room for difference of opinion regarding the admission to Mr. Pierce's letter of his plea for his own material. If the letter had not shown his connection with the Barber Asphalt Paving Company, it would have been a gross deception. Signed as it is, the letter is that of a special pleader, a fact that every reader will take into consideration.

Finally, it is entirely proper that anyone objecting to a communication such as Mr. Pierce's should voice that objection. It is with pleasure, therefore, that Mr. Cameron's letter is printed. We accord to his communication the same prominence given to that which he criticises.

Sanitary Control of Waterways

THE report of the committee on sanitary control of waterways, submitted to the sanitary engineering section of the American Public Health Association at Cincinnati, and printed on page 582 of this issue, indicates a crystallization of opinions, based upon economic, æsthetic and hygienic principles, which should have a marked effect upon regulations governing the pollution and use of streams.

To understand the report properly it is well to remember that the introduction of sewer systems about the middle of the nineteenth century, as the result of the investigations of the Health of Towns Commission, merely transferred the filth from the English towns to the watercourses. This abuse of the streams caused the appointment of the Rivers Pollution Commission, whose report led to the enactment of laws practically prohibiting the discharge of sewage as such into the streams.

Gradually from these opposite viewpoints reasonable opinions have been evolved, so that now sanitary engineers are able to recommend the economic treatment of sewage and the efficient purification of river water for public-water supplies, so as to provide for a normal use of streams and protect the public health. The report recognizes the impracticability of maintaining streams in their original purity, and that when properly carried out sewage disposal by dilution is a rational and suitable method.

One of the most difficult and yet important recommendations covers the requirements and the share of responsibility to be met by various users of streams. The adjustment of relations between sewage treatment, water purification and the shellfish industry comes properly under the jurisdiction of central authorities and the courts. The officials charged with administering such regulations should also consider the steadily increasing use of the streams, and define a policy which, while meeting present conditions, can be adapted to the more exacting demands of the future.

In the code submitted by the committee the æsthetic requirements are made that no objectionable deposits of local or general nuisance, due to excessive turbidity or odors, shall exist in streams, and the hygienic standard proposed would prevent undue burden upon water purification plants or potentially dangerous contamination of shellfish or bathing beaches.

The economic loss due to depreciated land values, and the necessary abandonment of streams for pleasure purposes, which result when a community allows its own sewage to foul its watercourses grossly, is becoming more evident to local authorities every year. The abatement of such conditions, from selfish motives, is easier to obtain than the prevention of pollution of streams at points beyond the interest of a town, but which prejudicially affects the comfort or health of users downstream.

This is where the central authority should intervene and require the proper use, and not abuse, of the stream, as recommended in the report. All those interested in conserving the natural resources which our watercourses provide should be governed in their actions by the principles enunciated in this report.

Mud-Dwelling Worms Suggest Sludge-Disposal Possibilities

ONE of the most interesting papers presented before the sanitary engineering section of the American Public Health Association at its recent convention in Cincinnati was that of W. C. Purdy, Plankton expert of the United States Public Health Service, on "Bottom Sediments." In connection with a study of the pollution of the Ohio River Mr. Purdy has investigated the bottom of the stream and found typical conditions of the sediments corresponding to the pollution of the water above them. He considers that the mud gives naturally an integration of the pollution conditions of the stream at any given point. Immediately below sources of pollution the mud was found to have a foul odor and a characteristic consistency, or pastiness, while farther downstream the odor improved and the mud became granular. Even more striking was the change in the number of mud-dwelling organisms—worms, insect larvæ and bivalves. In the pasty, polluted mud certain organisms, characteristic of pollution, were numerous, while in the granular deposits they were found in much smaller numbers. A count of the organisms, together with records of the odor and consistency of the deposit, can be made to serve as a sanitary index of the condition of a stream at any point except that in rapidly flowing streams allowance must be made for the inability of the deposits to form.

In the Ohio River above Cincinnati the mud at the river bottom contained about 5 "pollutional organisms" per liter; just below the city there were 455; 123 miles below the city there were 40 per liter. Below Louisville the increase was slight because of the swifter current which prevented bottom deposits from forming.

Mr. Purdy gave an interesting description of Limnodrilus, a red mud-borrowing worm over an inch long. With head embedded in the mud and its posterior extremity waving in the water above the mud, taking in oxygen and ejecting excretal casts, this organism gets its food from the organic matter and converts the pasty mud into a granular deposit. It is estimated that a single worm may eject excretal casts aggregating a length of 69 in. a day, the diameter being 0.18 mm. Apparently this worm does for the bottom desposits what the earth worm does for the soil. Chemical tests of the excreted matter showed it to have an "oxygen demand" less than half that of the original mud.

Several thoughts naturally arise from this study. Obviously the worms cannot live if the dissolved oxygen in the water falls below a certain amount, which thus determines a critical condition in the stream, for without the worms granulation of the mud does not occur and putrefaction by bacterial action with gas production becomes the controlling process. It will be interesting to learn what part these worms play in the change in sulphur compounds.

At the present time the great stumbling block in the economical disposal of sewage sludge is the difficulty of converting the sludge from a pasty to a granular condition. Drying is expensive, because as long as the pasty condition remains the evaporation takes place only at the surface. In the Imhoff tank gas production tends to increase porosity, but this process is slow. The use of yeast to accelerate gas production is being tried experimentally with some prospect of success. In the light of Mr. Purdy's investigation the thought suggests itself that possibly advantage may be taken of the action of worms in the granulation of sludge. As a matter of fact, this action is already being utilized in trickling filters, where larvæ and worms of various kinds are found in enormous numbers and where the effect is also in the direction of granulation. Perhaps some way will be found to utilize worm growth in the granulation of sludge in tanks prior to the drying or pressing. Biological studies should be made with this end in view.

More and more it is becoming apparent that we have studied bacteria too exclusively and that studies of the larger organisms, both animal and vegetable, should be included in the investigation of sanitarians.

Comments on the Government's First Tentative Valuations

"ORIGINAL cost could not be found." Considering the vigorous attempts of some of the state railroad commissioners last January to convince the Interstate Commerce Commission that reproduction cost had been definitely rejected by the courts, and that no basis of value was left but original cost, the foregoing sentence, with which the federal board dismisses original cost in its first tentative valuation report, that on the Atlanta, Birmingham & Atlantic Railroad (see notes on both this report and that on the Texas Midland Railroad on page 598 of this issue), is interesting. Perhaps the persistent contention of the railroads that original cost cannot be found was something more than an evasion of the issue after all. Of course the estimate method can be used, applying to the same quantities as in reproduction cost unit prices as of the date of construction; but those who have objected to reproduction cost on the ground that it is an estimate, which to them means a guess, might have trouble squaring estimated original cost with their consciences. The most righteous argument against original cost is that it does not in any event represent present value. But for the unthinking, evidence that a thing cannot be done is useful.

Why Separate Land?

Like the California railroad commission, the Interstate Commerce Commission switches from "cost" to "value" when it comes to deal with land. Unlike the California board, it does not add in this value to cost figures to get a cost total, but gives two sums, "cost of reproduction of road and equipment excluding lands," and "present value of lands." In the Texas Midland report the commission explains that it interprets the Minnesota rate decision to prohibit any allowance above normal market value, where this far exceeds original cost, but the segregation of the land accounts seems to indicate that the commission realizes that it is not reporting reproduction cost of land. Would it not be better for the commission to face the issue squarely? The Valuation Act calls for the reproduction cost of the entire property, including land. Has the commission found the Valuation Act and the Minnesota rate decision mutually incompatible, and if so would it not be proper for the commission to say so in its report?

Intangibles and Overhead

Of "other values or elements of value" the commission will apparently have none. Even development expenses, which the carriers class in this group, but which this journal contends are definite construction expenses, get no recognition, nor do appreciation, contingencies or working capital. The Engineering Record will not mourn the denial of advantageous location and its ethereal sisters, but regrets that such obvious necessities as contingencies and working capital, or such evident additions to value as appreciation, should be disregarded. Likewise the allowance for general expenditures—figured as percentages in the one case, estimated in detail in the other—seem at this distance to be impossibly low. An allowance of $831 for the organization of a $3,000,000 property suggests that the commission regarded the organization of the Texas Midland well-nigh automatic.

Depreciation of Overhead

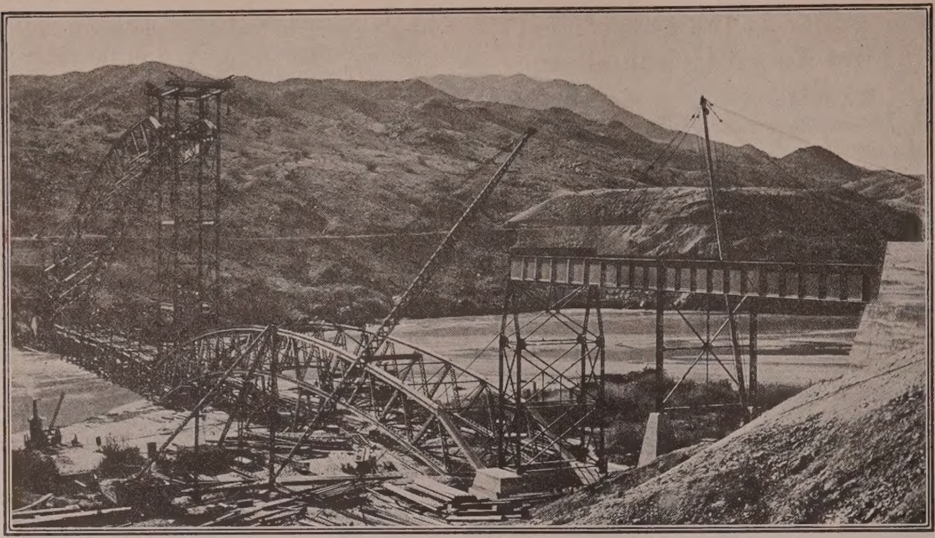
As the commission seems to be of open mind as to the correct way to figure reproduction cost new of general expenditures, it is apparently equally undecided as to the proper depreciation of overhead expenses. In the Atlanta, Birmingham & Atlantic report it depreciates all general expenditures, but not engineering; in the case of the Texas Midland engineering is depreciated, but none of the general expenditures are, except taxes and interest during construction. The deductions are explained, but considered together they do not quite harmonize. It would seem that one rule for the depreciation of overhead expenses should fit all railroads. It may be a coincidence that on the first two railroads reported on the conditions were so different as to necessitate disregarding in each case the conclusions reached for the same items on the other road; but there is unpleasantly suggested a lack of convictions on the part of the commission as to the proper handling of these items.

More Light Needed

The above-mentioned omissions and seeming inconsistencies appear from a perusal of the two valuations, without knowledge of the facts of the two railroads in question. Perhaps the commission has data to explain them away. Parts of the reports have already been discussed in informal conferences between the carriers and the commissions, and railroad valuation men have received through the Presidents' Conference Committee detailed criticisms by the companies involved, and by representatives of the committee. Objection is made to the programs of construction, the unit prices, the allowances for engineering and overhead, the omission of cost of acquisition of land and many other features of the valuations.

Probably some of the criticisms are prejudiced, but many of them look to be wholly justified. The carriers complain that the commission has not shown fully how it arrived at the figures it presents and that numerous figures required by the Valuation Act are missing. Under date of July 21 the Presidents' Conference Committee by letter urged the commission not to serve incomplete tentative valuations, but to consider the essential factors first. The commission declined the suggestion, stating that it had already considered these factors at several conferences, and had then announced that it would not issue definite rulings. Seemingly it would be well to revise this decision.

To strengthen the public faith in its ability to handle this tremendous problem of valuation, as well as to render substantial justice to all, the commission should open the doors and let all concerned see what it has done, and learn the reasons why.



HALF SPAN AND APPROACH ON ARIZONA END BEING CONSTRUCTED

Novel Method of Erection Adopted in Raising Longest Highway Arch Span

Old Trails Bridge Over Colorado River Has 592-Foot Steel Arch—Assembled in Horizontal Position and Raised by Tackle from Central Tower

EXCEPTIONALLY daring and successful for work of such magnitude was the method of erecting the trusses for the 592-ft. three-hinged arch highway bridge crossing the Colorado River at Topock, Ariz. Exceeding by 1 ft. the span length of the Detroit-Superior bridge in Cleveland, this span ranks third among arch bridges in this country and is the longest highway bridge of its kind.

After being assembled and riveted up in a horizontal position, the half-arch spans were raised into place by hoisting apparatus at a temporary central tower constructed by using floor steel from the main span. Both the local conditions at the site, which made the ordinary timber falsework expensive and dangerous and allowed the use of piles for the central tower, and the peculiar ball-and-socket type of center hinge suggested the unusual scheme of erection to the engineer of the fabricating company who devised the erecting methods and apparatus.

General Dimensions and Conditions

The bridge is located at Topock, Ariz., near the Red Rock cantilever bridge of the Santa Fé Railroad, crossing the Colorado River on the route of the national "Old Trails" highway. The river at this point is very swift. During construction of this bridge last winter it often ran from 15 to 18 miles per hour. The river bed is a fine silt, very changeable, the depth of this silt being from 80 to 100 ft. at the bridge site. The main stream is under the California half of the arch span, as can be seen in the photograph. A rise of 1 ft. would often result in scouring out 25 ft. of the silt, and after the completion of the bridge a rise of 4 ft. took out all the falsework except the piling under the center tower.

The total length of the steel superstructure is 832 ft., including the main 592-ft. arch of 32 panels at 18 ft. 6 in. each, with a rise of 100 ft., and approaches at each end consisting of two 56-ft. plate-girder spans carried on steel bents and towers. The main arch trusses are 25 ft. center to center, while the approach girders are 22 ft. on centers. The floor system consists of rolled I-beams, supporting a timber floor for a 17-ft. clear roadway.

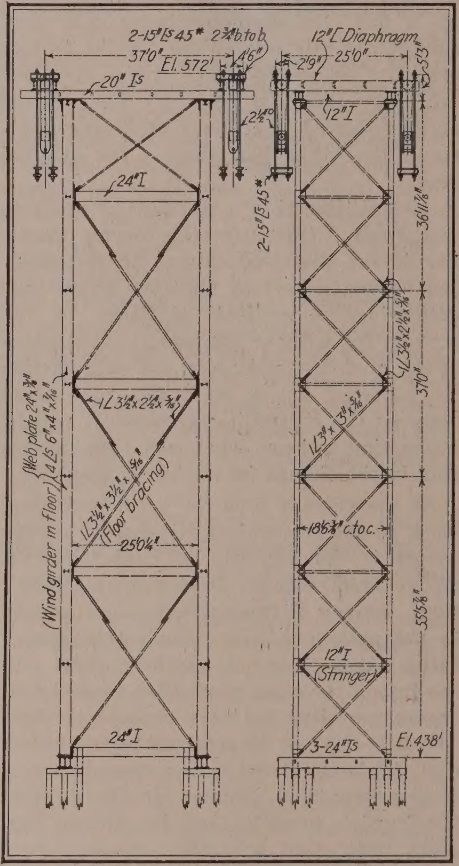
Why Special Erection Method Was Adopted

The extremely treacherous conditions of the river bed at the site, as described, made the usual method of erection by the use of high falsework not only very expensive, but also dangerous. As seen in the photographs, it was possible to erect the trusses in a nearly horizontal position with the use of very little temporary falsework. The trusses on the Arizona side were supported by several posts resting upon the sand. The California trusses on the other side of the river were supported upon pile bents, with the piles driven about 25 ft. into the silt of the river bottom.

These pile bents on the California side made a working floor for the erection derrick, and on this floor pony bents carried the steelwork. The piling was driven by a stiffleg derrick, similar to the one shown in the foreground of one of the pictures. The extreme length of boom used was 120 ft.

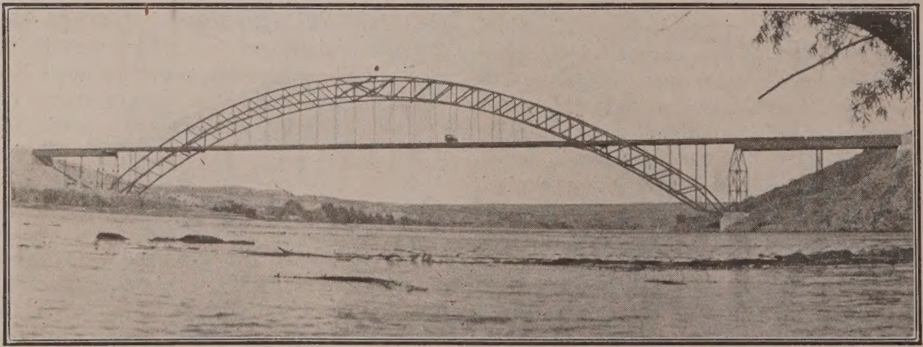
The scheme of erection thus adopted, which worked out with great economy and with complete satisfaction, included the construction of a temporary steel tower upon piling at the center of the span, using floor steel for the columns and bracing and hoisting apparatus with which the half spans could be revolved vertically into place around the end pins by raising them at the center. It was planned to avoid danger from a sudden washout of the falsework, under the California trusses, by supporting the trusses on the center tower and on the lower pin.

The main abutments were first constructed, the end hinges set in place and the trusses on the Arizona side built out on the sand bar from that side and continued to the center hinge. Piling was then driven into the river from the center tower to within approximately 60 ft. of the California end hinges. The California end hinges were next set and erection of trusses then proceeded toward the center tower, cantilevering across the 60-ft. gap by shore supports. Thus, should the falsework go out, the erected portion of the California trusses could be held by the central tower and the lower end hinges. The center hinges were thus located on top of the Arizona trusses, as indicated in one of the photographs.

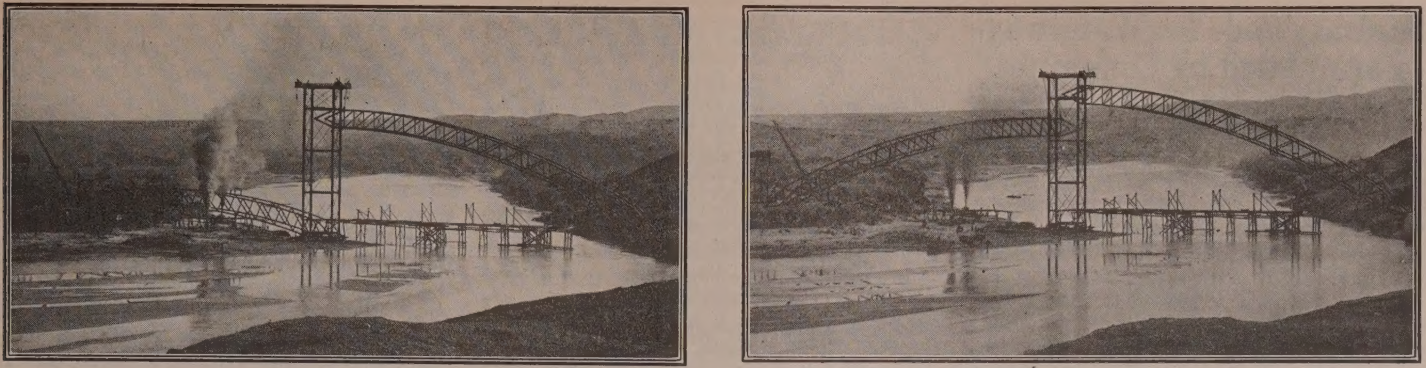


ERECTION TOWER REQUIRED LITTLE MATERIAL IN ADDITION TO FLOOR FRAMING

All joints in the main trusses were



COMPLETED 592-FOOT ARCH HIGHWAY BRIDGE—LONGEST OF ITS KIND



HALF SPAN ON CALIFORNIA END RESTING IN SLINGS WHILE THE OTHER HALF SPAN IS BEING RAISED

riveted up. Lateral struts and lateral diagonal rods were bolted loosely in position so as to allow some slight movement between the trusses during erection. Sufficient lateral bracing near the center hinge was left out to allow both half spans, when lying in the horizontal position, to pass the erection tower, which was made just wide enough for sufficient clearance.

DETAILS OF TEMPORARY TOWER

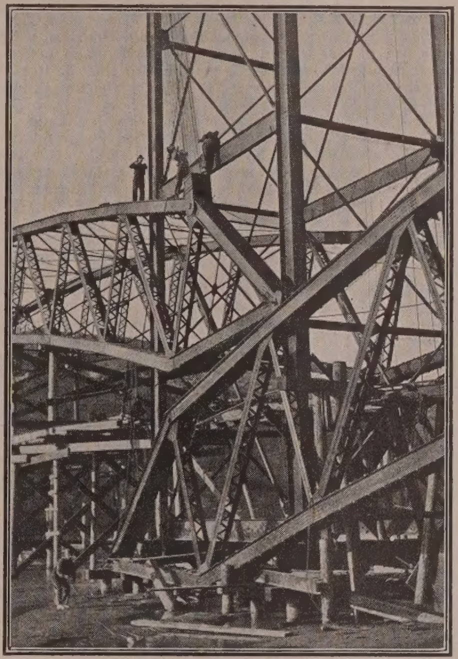
The columns of the temporary erection tower were made of the wind-chord girders from the main arch floor system, their finished length being just the proper length for use in the tower, so that no changes were necessary. The tower bracing was also taken from the main bridge floor, using I-beam stringers for horizontal struts and single-angle bottom laterals for the diagonal bracing. Thus all material except the connections and splicing angles and the special framing and hangers, as seen in the accompanying drawing, could afterward be used in the main structure. All connections were bolted, the bracing being connected to bent gusset plates on the columns.

The tower foundation consisted of thirty-six piles, nine at each corner, driven to an average penetration of 42 ft., cut at the top 2 ft. above low water and capped by 12 x 12-in. timbers. Across these, transverse 12-in. I-beam stringers distributed the load equally to the piles.

At the top of the tower, hoisting sheave blocks and special slings for supporting the California half span were carried upon I-beams as indicated in the drawing of the tower. Two 4-in. pins were provided for each load block. The same channels which supported these blocks were used to carry two sets of slings at the corners on the California side to support the half span after raising, and allow the same pair of sheave blocks to be used in raising the Arizona half. These slings each consisted of four 2½-in. round bolts 24 ft. long, threaded 6 ft. at each end.

RAISING THE ARCH TRUSSES

Two 30-hp. engines located on the Arizona shore were used to raise the half spans after they had been riveted up complete except for the lateral bracing, with end pins in position. Using a ⅝-in. cable and a 9-sheave upper block with an 8-sheave lower block, the California half span was raised first, the actual working time being about 15 minutes, and the total time 40 minutes. These trusses were raised about 3 ft. higher than their final position in order to allow the Arizona trusses to pass. This gave about 6-in. clearance. The sheaves were transferred to the other corners of the tower, and the Arizona trusses raised in a total time of about 30 minutes, and in the same actual working time as the California trusses.



PREPARING TO RAISE HALF-ARCH SPAN AT THE CENTER TOWER

About 6 hours were then required to lower the two sides together until the crown hinge came to a bearing. The auxiliary half hinges were then riveted up. So accurate was the shopwork that the final position of this crown joint when connected up was within ½ in. vertically and ⅜ in. laterally of the true position, allowance being made for temperature variations.

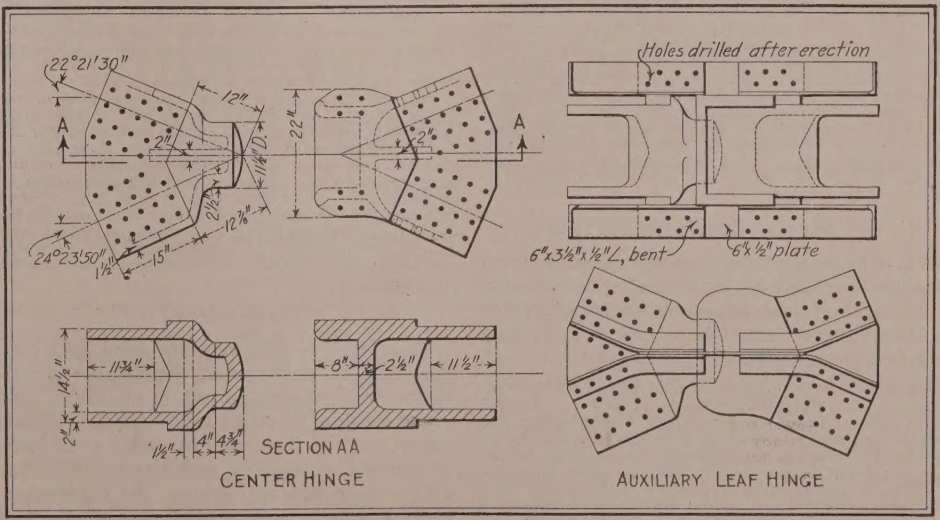
The center hinge of the ball-and-socket type is of cast steel, with a spherical compression bearing. As shown in an accompanying drawing, the milled head of convex bearing surface fits the concave spherical surface of a nickel-steel compression piece carried by the cast-steel hood attached to the other truss. For adjustment, steel shims of varying thickness could be inserted in the pan of the hood back of the nickel-steel compression piece.

For the purpose of tying the trusses together at the hinge and resisting any possible tensile stress which might be developed at the leeward hinge under excessive wind pressure, auxiliary leaf hinges as illustrated were provided, using 6-in. plates and bent angles to form a hinge flexible under rise and fall of the arch.

The method and details of erection were designed by A. M. Meyers, contracting engineer of the Kansas City Structural Steel Company, Kansas City, Mo., which fabricated the steelwork and erected the bridge. The design of the structure was made by J. A. Sourwine of San Bernardino, Cal., and J. P. Kemmerer acted as the latter's representative to inspect the work and superintend the construction. The total weight of the two arches is 360 tons, and the total cost of the bridge, including foundations, was nearly $80,000, paid jointly by the U. S. Commission of Indian Affairs and the states of California and Arizona. The bridge was completed and accepted on Feb. 20, 1916.

Pennsylvania Stream-Gaging Stations

Twelve new stream-gaging stations were established in Pennsylvania in 1915, making 110 stations from which the State Water Supply Commission receives reports.



DETAILS OF THE CAST-STEEL CENTER HINGE AND SPECIAL AUXILIARY LEAF HINGE

Sanitary Code for Waterways Formulated by Committee

Recommendations Regarding Stream Pollution Submitted to American Public Health Association

A CONCISE statement of the principles underlying the proper solution of waterway-pollution problems and a code of regulations for the sanitary control of waterways were the main features of the committee report submitted Oct. 26 to the sanitary engineering section of the American Public Health Association at its convention in Cincinnati. The committee which presented its findings consisted of Harrison P. Eddy, chairman; E. A. Fisher, Paul Hansen, Theodore Horton and W. H. Dittoe. The code of regulations proposed is as follows:

OBJECTIONABLE DEPOSITS

1. There shall be no objectionable deposits at any point in a waterway as a result of sewage or other wastes discharged therein.

To prevent such deposits public authorities should recognize the efficacy of such preventive and corrective measures as the dredging and removing of the deposits before they become objectionable, the proper location of sewer outlets and the removal of solids by screening, sedimentation, chemical precipitation and like methods.

2. There shall be no local nuisance created at or in the vicinity of any sewage or industrial wastes outfall, arising from excessive turbidity or the production of odors.

To prevent such conditions public authorities should recognize the efficacy of such preventive and corrective measures as the arrangement and proper protection of sewage outlets and all methods of sewage treatment in properly designed plants, including screening, sedimentation, chemical precipitation, oxidation in various types of coarse and fine-grained filters and treatment by the activated-sludge process.

3. There shall be no general nuisance created in a waterway due to excessive turbidity or to odors, as a result of sewage or other wastes discharged therein.

To prevent such conditions public authorities should recognize the efficacy of such methods of sewage treatment as are enumerated in Article 2, but it will be necessary to carry the treatment far enough to meet the following requirements:

(a) That dissolved oxygen shall be present in the waters of the waterway at all points and at all times in such quantities as to prevent the emanation of putrefactive odors.

(b) That every municipality or industrial establishment discharging sewage or wastes into a waterway may have its proper share of the dissolved oxygen, subject to the aforesaid limitation of Paragraph 1.

(c) That the share of dissolved oxygen of a waterway, which a municipality or industrial establishment may utilize at any time, should be subject only to the aforesaid limitation (stated in Paragraph 1), so long as other parties are not utilizing it nor thereby being deprived of its use.

(d) That as the size and number of municipalities or industrial establishments discharging sewage or wastes into the waterway increase, and the available share of dissolved oxygen for each decreases, treatment methods must be increased generally and correspondingly, in order that each party may continue to have the share of the available oxygen to which it is entitled.

PROTECTION OF WATER FILTERS

4. There shall be no interference with or undue burden upon mechanical operation or bacterial efficiency of water-purification plants procuring their raw water from a waterway.

The public authorities should recognize in this case:

(a) The efficacy of relocating water-supply intakes and sewer outlets as a means of remedy.

(b) The efficacy of such methods of sewage treatment as will reduce the quantity or alter the character of either that suspended matter or that dissolved matter, or both, which may interfere directly or indirectly with the mechanical efficacy and operation of water-purification plants.

(c) The efficacy of such methods of treatment as will reduce the number of bacteria which may cause a bacterial burden upon water-purification plants.

(d) That since water or sewage purification processes can be carried to any desired limit, at least theoretically, the share of responsibility which is to be imposed upon the different sewage-disposal and water-purification plants, with respect to extent of purification, will obviously depend upon a number of legal and administrative considerations of an economic, engineering and public-health nature which properly come within the jurisdiction of central authorities and the courts.

5. There shall be no active (potentially dangerous) bacterial contamination or gross pollution of properly located and authorized shellfish beds.

Public authorities should recognize in this matter five important features:

(a) The proper supervision, by competent authority, of the location of shellfish beds and drinking places, and suitable control of shellfish operation.

(b) That the gross pollution of shellfish beds by deposits of suspended matter from sewage or industrial wastes can be prevented, and that bacterial contamination of the beds may be avoided, by relocation of sewer outlets.

(c) That the gross pollution of shellfish beds by deposits of suspended matter from sewage or industrial wastes can be prevented also by the installation of proper sewage-treatment processes which will remove these solids to the extent necessary.

(d) That where shellfish beds are so located as not to be subject to gross pollution and where bacterial protection only will be necessary, this protection can be accomplished satisfactorily by the employment of such methods of treatment as will destroy or remove the bacteria.

(e) That since active bacterial contamination and gross pollution of shellfish beds can be prevented by proper location of such beds and by proper location of sewer outfalls and proper treatment of sewage and other wastes, the enforcement of the abandonment or relocation of shellfish beds or of preventive or remedial measures to protect such beds will obviously depend upon a number of legal and administrative considerations of an economic, engineering and public-health nature which properly come within the jurisdiction of central authorities and the courts.

6. There shall be no active (potentially dangerous) bacterial contamination or gross pollution of properly located and authorized bathing beaches and other bathing places.

The public authorities should recognize in this matter:

(a) That notwithstanding the legal rights of riparian owners, in view of our knowledge of the dangers to health arising from bathing in waters contaminated by the bathers themselves as well as from sewage and wastes discharged into them, control is needed both in the selection and authorization of bathing places and of the discharge of sewage and wastes into the waters in which bathing is authorized.

(b) That the gross pollution of bathing beaches by suspended matter from sewage or industrial wastes can be prevented, and bacterial contamination may be avoided, by relocation of sewer outlets.

(c) That where protection of properly authorized bathing places, from bacterial contamination only, is required, such protection can be secured by such sewage-treatment processes as will destroy or remove the bacteria.

(d) That where properly authorized bathing places require protection against gross pollution arising from suspended or other objectionable sewage matters, this additional protection can be secured by the installation of such additional sewage-treatment processes as will sufficiently remove the objectionable matters.

(e) That since active bacterial contamination and gross pollution of bathing places can be prevented by proper location of such places and by proper location of sewer outfalls and proper treatment of sewage and other wastes, the enforcement of the abandonment or relocation of bathing beaches or of preventive or remedial measures to protect such beaches will obviously depend upon a number of legal and administrative considerations of an economic, engineering and public health nature which properly come within the jurisdiction of central authorities and the courts.

CONCLUSION

Considerable misunderstanding and confusion exist as to what constitutes a nuisance or a menace to public health. These are questions of effect and intensity of pollution. They involve not alone principles of biology, chemistry and engineering, but also of law and psychology, the determination of which must be left to judicial and administrative bodies such as courts and state departments of health. It also appears to be a fact that whereas much may be accomplished in an endeavor to establish general limitations as to dilution, presence of organic matter, dissolved oxygen and other factors within which a nuisance or menace to public health may or may not be created, present knowledge of these relations is of such indeterminate and variable a character as to preclude definite formulation, and even were formulation possible, it could not usurp the offices of the courts and other judicial and administrative bodies in determining the facts and imposing remedies based upon such facts. It appears therefore that the code of regulations herein provided goes as far as present knowledge of the subject warrants.

Urges Skilled Operation of Sewage Works

State Supervision Indorsed in Report Presented by W. L. Stevenson to American Public Health Association

SKILLED supervision of operation, approval of plans by state boards of health, and selection of analytical tests which will give useful, rather than merely academic, information are among the most pressing needs in the field of sewage disposal, according to the report of the committee on sewage works operation, presented at the recent convention in Cincinnati of the American Public Health Association. These conclusions were reached by a committee headed by W. L. Stevenson of Philadelphia, and including F. E. Daniels, C. A. Emerson, Jr., C. B. Hoover and Richard Messer.

STABILITY TEST AT SMALL PLANTS

It is recognized that in a great number of small works, the purpose of which is primarily to prevent the creation of nuisance, only the simplest tests are practicable under present conditions, and it is recommended that in such cases samples of the final effluent be incubated at room temperature with methylene blue and that a record be kept of the number of days the samples retain their blue color. The required degree of stability depends largely upon the conditions in the receiving body of water. Where stability is demanded, on account of the dilution afforded being small, the samples of the effluent should retain their blue color at least ten or twelve days at room temperature or five or six days if incubated at 37 deg. C.

In selecting analytical tests for sewage works attention is again called to the importance of the fact that changes in methods of operation and records for comparison are the primary purposes of this work, and the acquirement of mere academic information, while interesting, is energy wasted which could better be expended in other directions.

Considering the number of municipal sewage-treatment works in America, it is surprising to learn how few are subject to laboratory control; but the newer plants are being so equipped and show the growing appreciation of the economy of proper operation.

FLOW SHOULD BE MEASURED

Another very noticeable defect in the design of a large percentage of works is the complete absence of any method of determining the amount of sewage treated. This is of prime importance to successful operation, for otherwise retention in tanks and rates on filters are indeterminate and it is difficult, if not impossible, to know whether unsatisfactory results are due to overloading of the parts of the works or to improper methods of operation. Where fall is available a weir, preferably with an automatic recording device, is a simple and inexpensive method to use. Where the sewage has to be pumped, the Venturi meter has proved successful.

THREE GROUPS OF STATES

The committee has divided the state boards of health in the United States into three groups as follows:

1. Those states whose boards of health either have no engineer upon their staff or have no specific legislation giving them control over the disposal of sewage, or have so few sewage treatment works under their jurisdiction that the subject is negligible. These twenty-three states in 1910 had a population of more than 24,250,000 or 26 per cent of the total population of the United States, and are: Alabama, Arizona, Arkansas, Colorado, Delaware, Georgia, Idaho, Mississippi, Missouri, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, South Carolina, Tennessee, Utah, Washington, West Virginia, and Wyoming.
2. Those states whose boards of health have an engineer or other officer charged with supervision over disposal of sewage, but whose legal powers are limited and the number of sewage-treatment works are small. The officers of this group of states have all signified their willingness to cooperate with the committee and have furnished valuable data. These ten states in 1910 had a population of 12,753,000, or 14 per cent of the total population of the United States, and are: Connecticut, Florida, Indiana, Kentucky, Louisiana, Maine, New Hampshire, North Carolina, Rhode Island, and Vermont.
3. The remaining states have boards of health with engineering divisions, and either have legal authority or otherwise exercise control over the disposal of sewage and operation of sewage-treatment works. The 1910 population in those states was about 54,000,000, or 60 per cent of the total population of the United States. In these states, generally, sewerage plants must be approved before construction and supervision, inspection and analyses are made, and in some reports of operation are made to the state board of health.

APPROVAL OF PLANS

The approval of plans for sewerage projects by the commonwealth is of great advantage to the community, institution or individual about to expend funds for the construction of sewers or sewage-treatment works, for it assures the carrying out of the work along comprehensive lines, which ultimately is economy; it prevents the construction of improperly designed works and tends to uniformity of practice throughout the state.

The supervision over operation and inspection of sewage-treatment works by the state in cases where works are efficiently operated becomes an indorsement more than anything else. In the case of the smaller works, which are frequently placed in charge of untrained and technically deficient operators, state supervision not only protects the commonwealth but makes possible the performance of the functions of the works for which they were designed and the funds invested.

The examination of the plans submitted should also include the fitness of the design and types of treatment to produce the quality of effluent demanded by the conditions of the receiving body of water. For example, it is unjust and a waste of public funds to approve, without comment, a complete treatment works for sewage to be discharged into a receiving body of water where neither the public health nor æsthetic conditions require at the present time more than preliminary treatment.

The committee has carefully considered the preparation of a standard form of report and has come to the conclusion that it is impracticable to do so.

Filter Patent Claims Invalid, Court Declares

Minneapolis Wins Suit Against Ira H. Jewell Involving Equipment of Mechanical Filter Plant

DECLARING invalid Ira H. Jewell's patent claims for the central control of operating valves and the use of a screen between the gravel and sand layers of mechanical filters for water purification, Judge William C. Hook, of the United States Circuit Court of Appeals, Eighth District, recently rendered a decision reversing the decision of the lower court and dismissing the bill of complaint against the city of Minneapolis. This action brings to a close litigation begun about four years ago and involving the equipment of the city's large filtration plant, which has been described in detail in the Engineering Record of Nov. 18, 1911, page 586, and June 21, 1913, page 680. The U. S. District Court decision upholding the claims which have just been declared invalid was noted in the Engineering Record of Aug. 7, 1915, page 181. The case which Minneapolis has just won was handled by City Attorney Charles D. Gould, who has furnished this journal with a copy of Judge Hook's decision, which is given below in full:

JUDGE HOOK'S DECISION

This case was appealed by the city of Minneapolis from the decree for an injunction and accounting for infringement of claim 1 of patent 649,410, and claim 14 of patent 649,411, both issued to the plaintiff, Ira H. Jewell, and dated May 8, 1900. The first of these patents relates to systems for controlling the operation of filters. Claim 1, held to be infringed, is as follows:

> 1. A filter provided with a system of controlling valves which are provided with actuating devices located so as to be accessible for control from a single position of an operator.

This claim is not for any particular, novel method of accomplishing the result indicated, but embraces broadly the idea of control of the valves of a filter from a central station or position. It is quite immaterial whether it was intended to apply it to a single filter unit or a series of units, or by actuating means, or by hand, hydraulic, pneumatic, or electric power. The claim is for an all-embracing central control.

CENTRAL-CONTROL PRINCIPLE COMMON

This is too common, familiar practice in other branches of industry to admit of the validity of a claim so broadly made. We refer to the patent to Cowles, No. 564,474, dated July 21, 1896, relating to improvements for hydraulic system for closing water-tight bulkheads on board ships, for opening and closing doors, hatches, ports, valves, cocks, gates, etc.

One of Cowles' specified objects was a combination of apparatus "whereby two or more independent, mechanical devices, which may be widely separated and of varying types, may be independently and systematically operated, controlled, continuously registered, and locked, all from the same point, central station or operating-board, and by one operator."

Cowles' idea of operating from a central position with mechanical devices is pointed out very clearly, and it is not important that he intended it principally, if not exclusively, as he says, to be applied to a hydraulic system on shipboard.

SCREEN NOT PATENTABLE

Claim 14 of the second patent reads as follows:

> 14. A filter comprising a tank having a tapered lower end, and an opening at the bottom of the same, a screen at the lower end of the tank in line with said opening, a granular filter bed within said tank, the part of said bed contained within the tapered portion of the tank being made of relatively large granules whereby water passing upwardly therethrough in washing the filter is laterally deflected so as to be distributed throughout all parts of the bed and a screen interposed between said larger granules and the part of the bed above the same.,

It was old in the filtering art to employ a filter medium inclosing in a bed of fine material like sand overlying one of coarser material like gravel.

It was desirable for efficient cleansing that the water in reverse movement be deflected and distributed so that it would reach every part of the filter bed, but particularly the overlying sand and leave no unwashed portions. We think it is too clear for much discussion that all of the elements of claim 14 are found in the prior patents to Hyatt, No. 322,103, 409,970 and No. 619,755, and the patent to Peterson, No. 222,731. These pertaining to the object above indicated and which it is contended the defendant is using in its municipal filter plant are shown in the last patent to Hyatt, No. 619,755, Feb. 21, 1899, excepting the screen interposed between the sand and gravel.

The plaintiff says that the screen is important as an aid in distributing the reverse flow of water to the superimposed bed of sand. This idea is an after-thought, born of litigation. The function of the screen is described in the specifications of the patents in suit as being "to prevent the pebbles from rising upward out of place when the filter is being washed by reversing the water therethrough"; and it is added, "In case the reverse current be under low pressure, said screen may be omitted."

NO NEW FUNCTION OF SCREEN

No such function for the screen as is now asserted was mentioned in the specification or stated in the claim, though it should be said that if the screen were novel and the function were actually performed, the omission would not deprive the plaintiff of the benefit. But it was old to have a screen between the coarse and fine layers of the filter bed. See patents to Peterson, No. 222,731; Hyatt, No. 322,103; Weiderman, No. 437,403, and Hefel, No. 603,483. If the screen performed the function mentioned by the plaintiff it would perform it in the older structures, though perhaps not in the Hyatt case as effectively, because the screen did not rest in contact with the gravel or larger particles of the filter bed. It is also said in high velocity washing the screen was to prevent disturbing the relative position of the sand and gravel. This was doubtless the principal reason for its use in the older structures and also in the plaintiff's, but in practice the gravel showed a tendency to be forced up and out of place. We do not think the insertion of a screen to prevent its doing so rises to the dignity of invention. It would naturally occur to a person ordinarily familiar with such work.

Let the decree be reversed and the cause remanded with directions to dismiss the bill.

Arizona Experiments with Oiling of Roads

Phoenix-Tempe Highway in That State Has Been Found to Take Oil Better When Surface Is Wet

MOST road surfaces are oiled best when dry, but the Phoenix-Tempe caliche road in Arizona takes oil better when the surface is wet, according to the latest report of Lamarr Cobb, state highway engineer, from which the following notes are taken. The physical condition of this road, the various substances used in its construction, caliche conglomerate and disintegrated granite and caliche, and the heavy traffic (1500 vehicles per day) made the proper selection of oil and its application difficult.

For the first application to 3.1 miles 75 per cent Union oil was applied at 250 deg. Fahr. by a Cannon distributor at the rate of 0.44 gal. per square yard. The screenings consisted of wash gravel ranging from ½ in. to dust, composed of fragments of granite, quartzite and rhyolite. The graveling at $1.70 per cubic yard, spread ½ in. thick, cost 2.37 cents per square yard. The oil at 4.39 cents per gallon cost 1.932 cents per square yard. Labor of preparing, oiling, screening and rolling cost 2.191 cents per square yard. Other costs were: Teams and wagon hire, 0.294 cent; heating oil, 0.258 cent; repairs and fuel for truck, 0.965 cent; superintendence, 0.375 cent; equipment, repairs and rentals, 0.375 cent; total, 8.76 cents. The shoulders were oiled for a total width of 14 ft. with crude oil, at the rate of 0.36 gal. per square yard, at a cost of 1.605 cents.

After letting the road wear a few months a second application of 90 per cent Roadamite was decided upon. First, the fat places were shaved off with a Russell grader pulled by a 5-ton Sauer truck. Then it was swept with a horse sweeper and finally cleaned with water and a squeegee.

The oil was applied at the rate of ¼ gal. at 325 deg. Fahr. and followed with washed gravel screenings and a steam roller. For 1700 ft. the treatment was varied somewhat. After the first application of oil and gravel to a depth of ¼ in., a horse sweeper with the broom locked was dragged over the road, touching it very lightly. A second application followed of equal amounts, after which a steam roller went over it. This section of double-oiled road gave an almost perfect wearing surface. The other, says the report, while not so perfect, is standing remarkably well. The second treatment cost 6.75 cents per square yard.

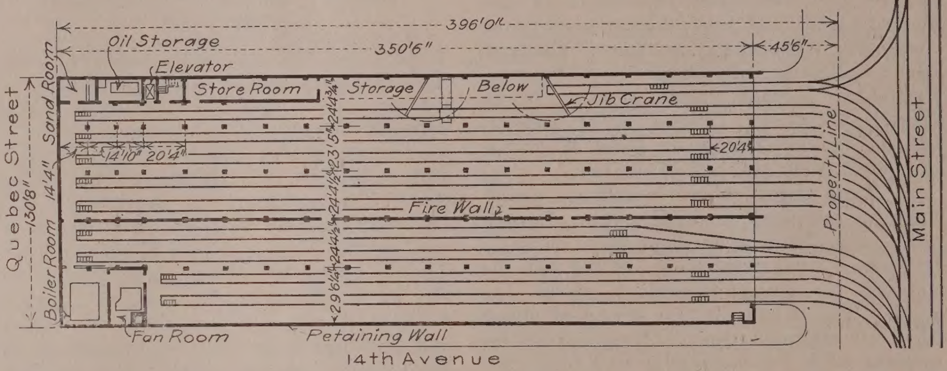
Two-Story Concrete Car Barn in Vancouver Designed with Steel Columns

Advantage Is Taken of Sloping Ground to Provide Double-Deck Storage Space for Cars — Entrances at Opposite Ends

ALTHOUGH the final completion of the structure as designed has been postponed on account of war conditions, the two-story reinforced-concrete car barn for the British Columbia Electric Railway Company, Ltd., Vancouver, B. C., will be unusual in the fact that car storage is provided on two levels to which access is obtained by entrances at opposite ends of the building. The elevations of the street tracks differ by about 20 ft. in the total distance of nearly 400 ft. between streets, and a counterfort retaining wall is used to provide the necessary resistance to earth pressure on one side and one end of the structure.

To save space and reduce the column spacing to a minimum, relatively slender built-up steel columns of the box type were used up to the second-floor beams of reinforced concrete, using concrete fireproofing cast with the latter. Track pits under all cars on the first floor were provided by supporting the rails and concrete slab platforms on reinforced-concrete piers. The new barn is located just south of a one-story timber-frame barn which was in operation, and it was required that the construction should proceed without encroachment on the existing yard on the south more than was absolutely necessary. This was accomplished by constructing the new concrete structure in two parts, the southern portion, including the fire wall which divides the building, being completed first.

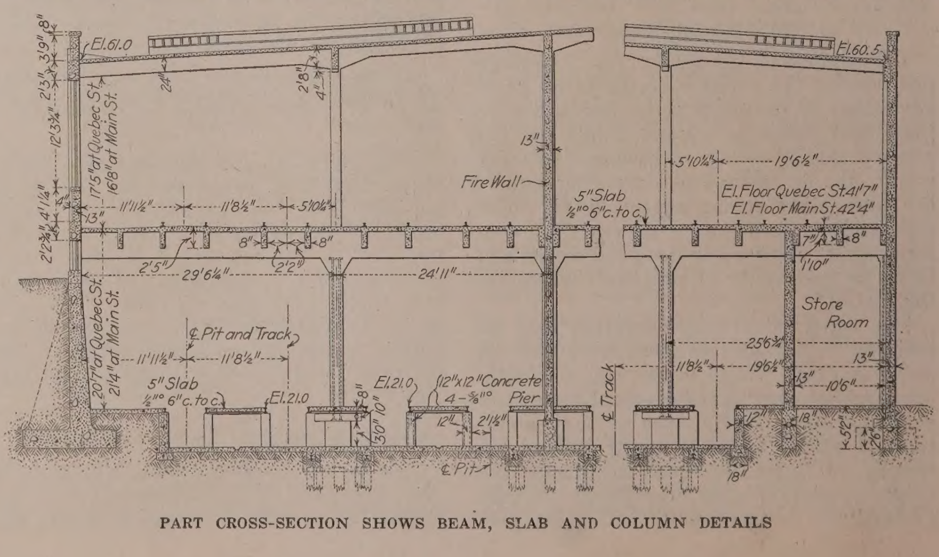
It is seen from the plan view and part section here shown that the new concrete building will be 350 ft. long, 130 ft. wide and about 40 ft. high on Main Street and 20 ft. high on Quebec Street. The difference in level of these streets at the ends of the building suggested the idea of doubling the storage space by making the barn of two-story construction, running the cars to be stored on the upper level half way around the block through Thirteenth Avenue on the north. This required a special design to support the heavy car loading on the second floor. Reinforced-concrete beams and slab were used, as indicated on the cross-sections herewith, with the beams placed under the rails in all cases except at the north side, where a turnout beyond the lunchroom, elevator and foreman's room in the northwest corner is necessary to locate the north, or tenth, track.



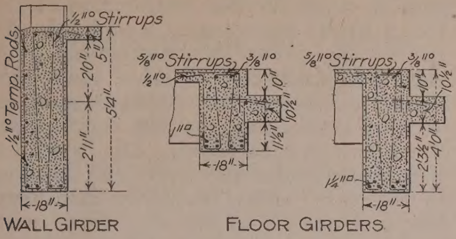
FIRST-FLOOR PLAN—MAIN STREET CARS ENTER ON FIRST FLOOR, QUEBEC STREET CARS ENTER ON SECOND FLOOR

By spacing the tracks 11 ft. 8½ in. on centers and using steel-core columns for the first floor, it is seen that the property width just accommodates ten tracks, placed in five aisles of two tracks each. In the northwest corner the sand room, oil-storage room and elevators are located, with a storeroom and general storage space below on the north side of the building, with jib cranes located as shown.

The design of the first-floor track supports was made to accommodate either a



PART CROSS-SECTION SHOWS BEAM, SLAB AND COLUMN DETAILS



SECTIONS OF SECOND-FLOOR GIRDERS

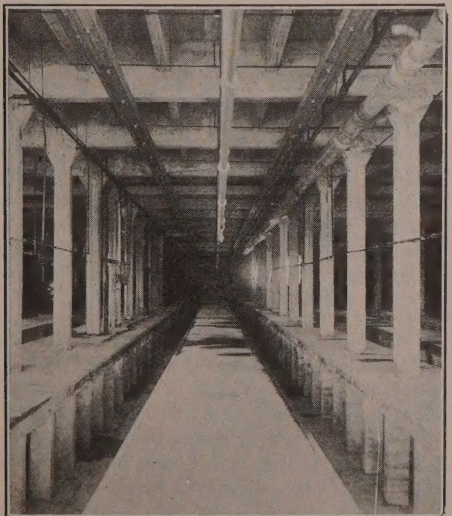
55-ft. interurban car weighing 82,000 lb. on four axles spaced 6.5, 25.5 and 6.5 ft. apart or a 43-ft. line car weighing 73,000 lb. on four axles spaced 6, 23 and 6 ft. apart. The second-floor design will accommodate the double-end city car over 42 ft. long weighing 47,500 lb. on four axles spaced 4.5, 13.6 and 4.5 ft. apart. On the spaces between cars the regular specified live load of 75 lb. per square foot was provided for. The working unit stresses in steel and concrete complied with the building law. The concrete-protected steel columns were designed without considering the concrete to carry any of the load.

The first-floor tracks and slabs are carried on 12 x 12-in. piers spaced about 7 ft. apart, and 4½ ft. high in order to give free access to the running gear of any car at any time. The steel rails, 7¼ in. deep, supported laterally by the concrete slab, act as beams between the piers. The main piers supporting the interior columns are of concrete about 8 ft. square, reinforced by ¾ in. rods, and capping the ten timber piles used to increase the bearing power of the foundation soil.

STEEL COLUMNS USED

The second floor is supported by box columns of steel composed of two 9-in. or 10-in. channels with two 12-in. plates, protected on the outside by 4 in. of concrete and filled with concrete to prevent corrosion on the inside. This concrete, a 1:2:4 gravel mix, was poured with the beams and slab of the second floor, with brackets as indicated in the photograph. The south part of the building was constructed first, up to the 13-in. fire wall, allowing the use of the storage yard on the south of the old barn until the first part of the new building could be used.

The retaining walls, of the reinforced-concrete counterfort type, with counterforts spaced about 8 ft. apart, were constructed on the south and west, the height of the west wall decreasing with the grade of Fourteenth Avenue and surmounted by a wall containing windows as soon as the grade permitted sufficient clearance. The building is sprinkled by the dry-pipe system. When completed, a 35,000-gal. water tank will be placed on the roof, supported on a steel tower over a bay near the center of the building. The construction and design were carried out by Westinghouse Church Kerr & Company of Montreal and New York, with H. H. Forsyth acting as engineer in charge and J. F. Single as superintendent at Vancouver. The steel columns were fabricated by the Canadian Northwest Steel Company of Vancouver, B. C.



VIEW OF TWO-TRACK AISLE—PIERS SUPPORT RAILS AND PLATFORMS BETWEEN TRACKS

Reviews Refuse-Collection and Disposal Methods

More Investigations Made—Collection End Getting Attention—Michigan to Test Plants During Operation

A RESUME of developments in refuse collection and disposal for the last year given by S. A. Greeley, chairman of a committee on the subject, to the American Public Health Association, Oct. 27, indicates that there is a growing interest in the Cobwell system of reduction, and that supervision over maintenance by state boards of health has already started.

Plants of the Cobwell type have been built at Los Angeles, Cal., the Panama-Pacific Exposition, and New Bedford, Mass. A plant located on Staten Island is proposed for New York City. The feature of the process is that the cooking, de-watering, de-greasing and drying of the garbage are carried out in one receptacle without exposure to the air. After the garbage is placed in the receptacle nothing is exposed to the air until the tankage is taken out ready for shipment. The chance for odors, it is claimed, is thus largely reduced.

Many small incinerating plants have been built. There has been a uniform advance in the disposition of city officials to give more attention to the investigation and the preparation of plans and specifications in advance of construction.

During the year investigations and reports have been made at Kansas City, Washington, Danville, Ill., and Galesburg, Ill. A particularly important feature in these reports is the special attention that has been given to the collection part of the problem, both as regards the cost and location of disposal works and the efficiency of the service as a whole.

One of the interesting court cases at San Francisco on the question of fulfillment of guarantees for a refuse incinerator is to come to trial. This case is similar to that which was on trial a year ago at Atlanta. At Worcester, Mass., hearings producing valuable information have been held on the operation of the city pig farm for garbage disposal. At Philadelphia the question of whether odors resulted from the sewage pollution in the Schuylkill River or rendering plants formed a large part of the controversy.

At New York, at present, there is much interest over the location of a large garbage-reduction plant on Staten Island. The officials of the city of New York favor the undertaking, whereas the residents of Staten Island have combined in an attempt to prevent the location of the plant at this point. No settlement has been reached.

The Michigan State Board of Health has undertaken to make tests of all newly installed garbage plants, and, where practical, is having recording pyrometers installed at incinerators. At Milwaukee and Savannah a considerable amount of steam has been generated at mixed-refuse incinerators and made useful for other purposes in the municipality. At Savannah steam is used at the waterworks pumping station. At Milwaukee the steam is used for generating electricity, which has been sent several miles to pumps which discharge lake water into the Milwaukee River for flushing purposes.

Old Sandstone Blocks Serve as New Pavement Foundation

Topeka Railway Company Intends to Utilize Them in Repaving Ten Miles of Track—Cost Less Than Solid Concrete

OLD Colorado sandstone blocks that have given thirty years of service—they were laid in 1886—are being utilized in place of concrete for the base of the new brick pavement being laid by the Topeka (Kan.) Railway Company. After shifting the track, a 2 x 9 ft. trench is dug and a 1-in. layer of cinders put down, which is followed by a course of the sandstone blocks, which are 6 x 6 x 8 in. Grout, mixed by hand, is then brushed into the crevices between the blocks. The 85-lb. railway track is then moved back upon this foundation and the spaces between the ties are filled with Joplin chats. This is followed by a 3-in. course, which joins on either side a similar pavement foundation put in by the city. On top of this base a regular sand cushion and 4-in. brick block paving are laid across the street.

LABORERS MIX GROUT BY HAND AND BRUSH IT INTO CREVICES

The Topeka Railway Company has a stretch of 10 miles of track with a surface paving of sandstone block which it intends to repave in the manner described. The pavement is claimed to be less expensive than solid concrete work and, in the opinion of the company, will support the street railway adequately.

Asphalt Covering for Trestles

The Southern Pacific Railroad uses untreated timber for decking over trestles which are to be ballasted. By omitting the treatment the maximum strength in the timbers is available and they are protected from moisture and sun by an asphalt covering.

New Tables to Aid Design of Concrete Form Supports

Construction Practice Recommended After Illinois Factory Bureau Finds Collapse of Poor Forms Serious Accident Factor

AFTER an investigation of the collapse of numerous concrete buildings, the Illinois Department of Factory Investigation concludes that the danger of these occurrences would be greatly reduced if more attention were paid to form design. With that point in mind, the bureau presents in its report an article by Ernest McCullough, chief engineer of the Fireproof Construction Bureau, Portland Cement Association, outlining practice in the design of floor form supports which is recommended as standard for such construction.

TABLE 1—SLAB NUMBERS

Slab number	Slab thickness in inches of solid slab	Combination tile and concrete	Slab number	Slab thickness in inches of solid slab	Combination tile and concrete
1	3	..	10	7	13
2	4	6	11	..	14
3	..	7	12	8	..
4	..	8	13	..	15
5	5	..	14	9	..
6	..	9	15	10	..
7	..	10	16	11	..
8	6	11	17	12	..
9	..	12			

TABLE 2—POSTS FOR CENTERING

3 x 4-in. solid, to be spaced 4 x 6 ft. or less, under slabs 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, braced in four directions every 7 ft.
To be spaced 4 x 4 ft. or less under slabs 11, 12, 13, 14; 15, 16, 17, and 4 ft. apart under girders or beams.
4 x 4 in. solid, or T post of two 2 x 4 in. properly spiked.
To be spaced 6 x 6 ft. or less under slabs 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, braced in four directions every 8 ft.
To be spaced 4 x 6 ft. or less under slabs 11, 12, 13, 14, 15, 16, 17, or 5 ft. apart under girders or beams.
6 x 6 in. solid, or T post of 2 x 4 in. and 2 x 6 in., properly spiked, braced in four directions every 8 ft.
To be spaced 6 x 6 ft. or less under slabs 12, 13, 14, 15, 16, 17, or 6 ft. apart under girders or beams.

TABLE 3—SIZE AND SPACING OF JOISTS ON 4-FOOT SPANS

Slab number	Size, inches	Spacing, inches
1	2 x 4	16
	2 x 4	24
2 to 15 inclusive	2 x 6	24
16	2 x 6	21
17	2 x 6	21

TABLE 4—SIZE AND SPACING OF JOISTS ON 6-FOOT SPANS

Slab number	Size, inches	Spacing, inches
1, 2	2 x 6	16
	2 x 8	24
3	2 x 6	15
	2 x 8	24
4, 5, 6	2 x 6	14
	2 x 8	24
7, 8	2 x 6	12
	2 x 8	24
9, 10, 11, 12, 13	2 x 6	12
	2 x 8	21
14, 15, 16, 17	2 x 8	21
	2 x 8	18

TABLE 5—MINIMUM SIZES OF GIRDERS ACROSS POSTS ON 4-FOOT SPAN, SPAN OF JOISTS 4 FEET OR 6 FEET

Slab number	Size, inches
1, 2	2 x 10, 3 x 8 or 4 x 6
3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	2 x 10 or 3 x 8
14	2 x 10, 4 x 8 or 6 x 6
15	3 x 10, 4 x 8 or 6 x 6
16	3 x 10 or 4 x 8
17	2 x 12, 3 x 10 or 4 x 8

TABLE 6—MINIMUM SIZES OF GIRDERS ACROSS POSTS ON 6-FOOT SPAN, SPAN OF JOISTS 4 FEET OR 6 FEET

Slab number	Size, inches
1	2 x 12 or 3 x 10
2, 3	3 x 12, 4 x 10 or 6 x 8
4, 5, 6, 7, 8, 9	2 x 14, 3 x 12, 4 x 10 or 6 x 8
10	2 x 14, 3 x 12, 5 x 10 or 6 x 9
11	3 x 12, 6 x 9 or 7 x 8
12, 13	3 x 12, 5 x 10, 6 x 9 or 7 x 8
14	4 x 12, 5 x 10 or 6 x 9
15	3 x 14, 4 x 12, 5 x 10, 6 x 9 or 8 x 8
16	2 x 16, 3 x 14, 4 x 12, 5 x 10, 7 x 9 or 8 x 8
17	2 x 16, 3 x 14, 4 x 12, 6 x 10 or 7 x 9

When it is considered that the cost of the forms amounts to about one-third of the entire cost of the work, it seems strange, continues the report, that many contractors should leave this work to foremen. Its proportionate value suggests that it should be intrusted only to a designing engineer or architect. One example is cited where, due to weather conditions, the concrete set very slowly. When the second story was added, the first floor collapsed. Evidently the fact that the supports had to carry the load of both floors until the first floor concrete had attained its strength was neglected in designing the centering. It is concluded, however, that foremen and contractors without technical training must not receive all the blame, as there has been no guide for them to follow. Though numerous books on concrete design and construction exist, there have been no comparable works published on the design and construction of forms.

CONDEMN POSTS MADE OF PIECES NAILED WITH FLAT SIDES TOGETHER

All centering posts, it is stated, should either be one solid piece, as 4 x 4 in., or should be T-shaped. The strength of such a post properly made is given as two-thirds that of a solid piece of the same overall dimensions. The practice of using two 2 x 4-in. pieces spiked together should not be allowed, as the pieces cannot be loaded equally. Also, the use of short posts with several blocks underneath should be abandoned, as the blocks may be accidentally knocked out. Moreover, if they are not properly placed under the posts the latter may slip off these built-up blocks. However, the posts should not rest directly on the concrete floors, as this would concentrate too great a load on a small area. For spacing of 4 x 4 ft. a 2 x 12-in. plank is recommended; for 4 x 6-ft. spacing, 3 x 12-in. plank and for 6 x 6-ft. spacing, 4 x 12-in. plank.

Care should be taken to have the posts vertical. They should be tied together in four directions at such intervals that their greatest unsupported length will not be more than 30 times the least thickness. Posts should be spaced at intervals not exceeding 6 ft. The girders should be centered over the posts and should be braced at 4-ft. intervals. The use of blocks under the girders should be avoided. If wedges are employed, they should be in pairs and should be as thin as possible. The accompanying tables, 1 to 6 inclusive, give the minimum sizes and maximum spacing of joists, girders and posts, as determined for the load conditions outlined in the first table.

GOOD PRACTICE IN CONCRETING

In building construction Mr. McCullough recommends that forms be provided for not less than three floors when the temperature is above 50 deg. Fahr. In the case of work done in cooler weather, the amount of centering should be increased accordingly. After the slab, girder, beam and column forms have been removed, one-half of the centers should be put back, to remain in place for at least a week or until the concrete has dried out and hardened. The length of time recommended under varying conditions as necessary before the forms can be removed is given in Table 7.

HOW TO TELL FROZEN CONCRETE

The method of constructing a dam inclosing several square feet of floor and filling it with several inches of hot water is stated to be the most reliable for determining whether concrete is frozen. The water should have a temperature of not less than 150 deg. Fahr., but should not be boiling. If the concrete is frozen, it will soften in a few minutes.

Mr. McCullough further advises that if the temperature during the working day falls below 50 deg. Fahr., the building should be inclosed. If it falls as low as 40 deg. Fahr., salamanders should be installed, and if it falls below 40 deg. Fahr., the concrete ingredients should be heated and care should be taken to eliminate frozen lumps of material.

TABLE 7—TIME REQUIRED BEFORE REMOVING FORMS

	Above 60 deg. Fahr.	50 to 60 deg. Fahr.	40 to 50 deg. Fahr.	Less Than 40 deg. Fahr.
Columns	Within 3 days	5 days	Not less than 10 days	Not until tests have been made indicating that the concrete is set.
Side forms for girders and beams	Within 4 days	6 days	Not less than 10 days	
Bottom forms of slabs (6 ft. or less span)	*Within 4 days	8 days	Not less than 14 days	
Bottom forms of beams and girders (less than 14 ft. span)	*Within 14 days	18 days	Not less than 14 days	

*Add 1 day for each additional foot of span.

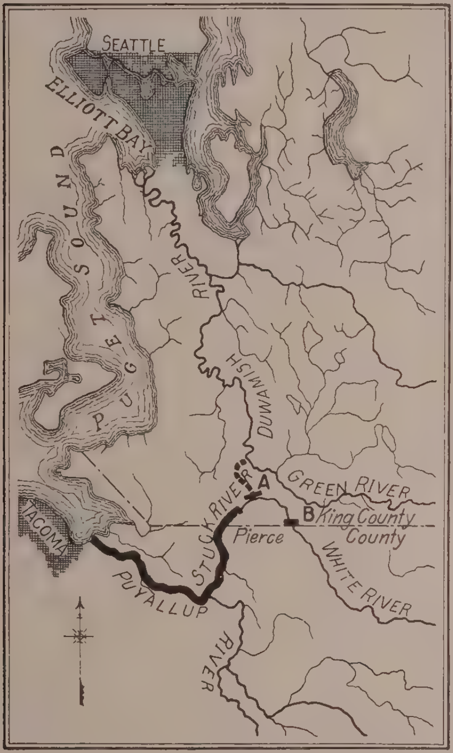
Photographs from Aeroplanes for Reconnaissance Aids

For use in preliminary studies in working out an elaborate scheme for beautifying the city of Santa Barbara, and as an aid in examining possible locations for a proposed sewer outfall, photographs were recently taken from a hydroplane showing the general appearance of the city from above. The views bring out clearly the general contour and the relative position of the city with regard to the sea and the mountains. The actual use of such photographs as adjuncts to maps provoked some local comment on the possibilities of this kind of photography as a more generally useful aid in engineering studies. For example, one engineer pointed out that "after every flood season the overflow channels of the Colorado River in the neighborhood of Volcano Lake are radically different from those of the preceding season. It is a very difficult country to survey at any time, but particularly so after a flood, as there are always bottomless lakes of liquid mud that cannot be traversed on foot or by boat. The use of an aeroplane would make it possible to take photographs that would give the desired information quickly and accurately." The Los Angeles Weather Bureau has used an aeroplane for about six months in making meteorological reconnaissance, it was stated, and engineers who have interests in Mexico suggest that when political conditions there have quieted down a demand will be felt for aeroplane reconnaissance of country which is rugged, and at the same time thickly overgrown, to a degree that makes it extremely difficult to make topographic studies off the beaten track.

Divert Flow of White River, Washington, to Tacoma

King and Pierce Counties Carry Out Work—Diversion Dam, Drift Barrier and Channel Rectification Involved

PRIOR to 1906 the main discharge of the White River emptied into Elliott Bay at Seattle. A small portion of the flow, averaging about 500 sec.-ft., left the main stream on an inland delta 40 miles from the mouth, flowed southward into the Puyallup River and thence into Puget Sound at Tacoma, a distance of 20 miles. This connecting link between the White and Puyallup Rivers was known as the Stuck River. Topographical conditions on the inland delta were such that the shifting of a bar or accumulation of drift would divert the river north or south overnight. This did occur, in fact, in November, 1906, when high-water conditions turned all of the White River through the Stuck valley and thence to Tacoma by the Puyallup River.



MAP OF INTERCOUNTY RIVER IMPROVEMENT

King County desired to make this channel permanent by artificial means, but the situation was complicated by the fact that the King-Pierce County line passed near the point of diversion and only a short bend of the original channel was in the former county. Pierce County authorities attempted to make King County take the river back and allow it to empty into Elliott Bay as before; but King County disclaimed all responsibility in the matter. Finally in 1913 the state legislature passed the Intercounty River Improvement Act, providing for the establishment of funds to carry out the necessary work. A tax levy of one mill in Pierce County and 0.6 mill in King County provided $250,000 per year for six years—a total of $1,500,000—for construction, with a maintenance fund of $50,000 a year for 99 years.

It was decided that the entire flow would be conducted through the Stuck-Puyallup route to an outlet at Tacoma, as shown. A diversion dam was built at the point marked A on the map. The work to be done was accordingly classified under three heads—removal of drift, rectification of channels, and bank protection. The point B marks the location of the drift barrier. The contract for channel rectification, which involved the excavation of 3,000,000 cu. yd. of earth, was let to the Puyallup Dredging Company. That part of the river on which improvements were made is indicated by the heavy line on the map. Under the terms of the contract the county supplied an electrically operated dredge, the details of which are given in another article in this issue.

Electric Power to Dredge a Relocated River Channel

Washington Counties Build Dredge Operated by 800-Horsepower Motor—Contractor Buys Outfit When Work Is Done

By J. H. WALTER

TO CARRY OUT the contract for channel rectification on the Puyallup River on the intercounty river-improvement project in Washington an electrically operated dredge was constructed at a cost of $70,000. Under the terms of the contract the counties supplied the dredge, which the contractor agreed to purchase at the termination of the work at 75 per cent of its original cost. The job of handling 3,000,000 cu. yd. of earth was let to the Puyallup Dredging Company. During the work the municipal plant of Tacoma supplies current at the rate of 0.45 cent per kilowatt-hour.

DREDGING MACHINERY

The hull of the dredge, which was built specially for this river work, is 155 ft. long, 40 ft. wide, and has a depth over all of $9\frac{1}{2}$ ft. It is built with 10 x 12-in. bottom and 10 x 18-in. bulkhead timbers. The design is such that all machinery is located on deck and not inside the hull, thus making recourse to trussing or framing unnecessary. The longitudinal timbers are all long lengths. Three interior cross-bulkheads are secured with 1-in. staybolts. The stanchions are 10 x 10-in. timbers and 10 x 10-in. deck beams. The rigidity was increased by using 4 x 12-in. cross-bracing. The hull is divided into ten watertight compartments, with a separate compartment, as water tank, for the boiler. In building the hull 170,000 ft. b.m. of lumber and 27,000 lb. of iron and steel were used.

The dredging equipment proper consists of a rotary cutter suction head and a 20-in. centrifugal pump with a direct-connected motor. The digging ladder is built up of 24-in. 100-lb. I-beams 52 ft. long. The cutter shaft bearings, which are set on top of the ladder, are of standard pattern with the exception of the one forward and an outboard bearing in the suction head. These have cast-iron glands in place of babbitt, to allow for the excessive wear on account of grit and to permit of quick and economical renewals. In these two bearings the cutter shaft is provided with cast-steel sleeves.

STRAIGHT-BLADE CUTTER

The cutter was originally of the helmet type, but has been replaced with a straight-blade cutter on account of encountering very hard clay strata. The cutter motor is mounted on a framed base in the port tongue of the ladder well and transmits its power through the port trunnion on a 60 to 1 reduction. The 20-in. cast-iron suction pipe passes from the cutter head up the digging ladder and through the starboard trunnion. The clearance provided in the trunnions is such that the weaving of the ladder when snags are encountered does not affect either the suction pipe or the cutter transmission.

The bullwheel on the cutter shaft is 86 in. in diameter and has an 8-in. face. Special collars are provided for the end thrust of the cutter shaft. The suction head carries a back ring for the cutter, 6 ft. in diameter. The swinging plates are located far enough back from the cutter to keep the swinging blocks free from sand and grit. The 8-in. cutter shaft is in three parts connected by standard couplings.

The pump itself is a 20-in. Bucyrus convolute, with front and back lining and a renewable nose ring and stuffing box. The pump shell and runner are high-carbon annealed-steel castings; the front and back heads are medium steel castings, and the nose ring is of cast iron. The liners, which are of plate steel, are in one piece. The runner shaft is hammered steel, 9 in. in diameter, with one oil-ring bearing. The pump casing, together with these three bearings, is assembled on a cast-steel base, with a structural sub-base between this and the structural bed. This bed is built up of six 12-in. I-beams running the full length of the unit and plated top and bottom with $\frac{1}{2}$-in. steel. The bed sets directly upon and centers the five center bulkheads of the hull to which it is bolted. This construction has been so carefully installed and fitted that there is not the least vibration when the unit is running full capacity.

The 20-in. suction and discharge pipes are of cast-iron $\frac{7}{8}$ in. thick and have flange connections. Immediately behind the pump in the discharge line is a 20-in. cast-steel flap valve to control the back flow when the pump is shut down. This is designed with a renewable valve seat and an unobstructed

800-HORSEPOWER ELECTRICAL SUCTION DREDGE USED ON INTERCOUNTY RIVER IMPROVEMENT passage for material, and is fitted with an outside hand lever and counterweight.

The dredge is held in position by two steel-shod stern spuds, 50 ft. long, in cast-steel wells 14 ft. apart. The leads to the spuds run direct from the headblock on the spud tower to the spud drums of the winding machinery.

ELECTRICAL EQUIPMENT

The dredging pump is driven by a direct-connected 800-hp. 3-phase 2200-volt motor, operated at 360 r.p.m. (synchronous speed). The motor is designed for continuous operation at any speed from 33 1/3 per cent reduction to full speed, and for two hours when developing 25 per cent overload, or for 50 per cent momentary overload, without undue strains or overheating. The cutter motor, operated at 2200 volts, is rated at 75 hp. for 600 r.p.m. (synchronous speed), and is similar to that which drives the winding machinery. Both are reversible induction motors and allow continuous operation for two hours at 25 per cent overload.

While the cutter and winding-machine motors have standard drum-type controls, that for the pump is equipped with contactor and master control. The resistance grids for the latter are mounted in a well-ventilated house abaft the pilot house and atop the main deck structure. All controls, including the levers operating the various drums of the winding machinery, together with the three motors, are in the pilot house forward. The switchboards are made up as follows: Panel 1, incoming line; panel 2, 800-hp. induction motor; panel 3, 75-hp. induction motor; panel 4, 75-hp. induction motor; panel 5, lighting and small power.

The pilot house also contains pressure and steam gages, the digging gages and graduated dummy gage connected to the ladder to indicate the depth of cutter and vacuum. The winding machinery has an auxiliary double 10 x 12 steam engine, with movable coupling to line shaft. This arrangement permits using the winding machinery, irrespective of electrical power.

STEAM PLANT

The boiler is kept constantly under a full head of steam and the engine is limbered up every day. Steam is supplied at 120 lb. by a Clyde type boiler located on the main deck at the stern and jacketed with 2-in. asbestos blocks. Steam is also supplied to a 4-in. ejector for priming the main dredging pump and to a 12 x 7 x 12-in. Fairbanks-Morse pump which handles the bilge and can be used for fire service. This pump is so connected that water can be drawn through a 6-in. line from any of the ten watertight compartments or from outboard. There are four 2-in. fire hydrants on the dredge which are fed through a throttling valve, so that any desired pressure can be secured. A 2-in. relief valve on this line affords safety against overpressure.

With the dredge there were furnished 12 pontoons, 500 ft. of 7-gage riveted pipe with dredging sleeves, 3000 ft. of 10-gage riveted levee pipe and the necessary couplings. The pontoons are 12 x 24 ft. in plan, 2½ ft. deep, and four of them are equipped with turntables so that the obstruction to cross-currents can be reduced to a minimum. It was found advisable to build a 26 x 48-ft. derrick scow as a dredge tender, equipped with a 9 x 10-in. 3-drum hoisting engine and a 40-ft. boom stifflegged derrick. This scow is used in removing drift and snags from the channel and for general repair work around the dredge.

In a test run to determine the efficiency of the pump unit a 3000-ft. length of discharge line was laid to obtain 25 ft. difference in elevation between the end of the discharge and the surface of the water at the dredge. Owing to the fact that a uniform formation was seldom encountered while digging, only a clear-water test was made. The velocities were measured by placing 6-in. wooden balls in the suction pipe and noting the time of transit to the end of the discharge. Also, 1-gal. jugs of potassium permanganate were used, the jug breaking in the pump and coloring the water. Fairly uniform results were secured in eighteen trials.

The vacuum pressure and power-consumption ratings were taken at intervals of one hour or less over a period of 19 hours' steady running. The only difficulty—holding the land pipe together—arose from the fact that the line was assembled hurriedly; and as only clear water was pumped, there was no silt to close up the joints. The results of the test run showed that the average pressure was 43 lb., equal to a 98.9-ft. head, and the average vacuum was 19 in., equal to a 21.5-ft. head. The total equivalent head was therefore 120.4 ft. With a velocity of 15.3 ft. per second the horsepower output equals 456.3. The power consumed equals 505.8 kw.-hr., or 678 hp. input, which gives 67.3 per cent efficiency of unit. Assuming 90 per cent motor efficiency, that of the pump would be 75 per cent.

W. J. Roberts is chief engineer of the Intercounty River Improvement. The writer, as principal engineer, designed the dredge and equipment, supervised its construction, and operated the outfit for sixty days, at the end of which time it was turned over to the Puyallup Dredging Company.

Public-Utility Commissions Should Regulate, Not Operate, Corporations

Paper Presented Oct. 11 at the Joint Convention of the Illinois and Iowa Sections of the American Waterworks Association

By LEONARD METCALF
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PUBLIC UTILITY activity did not begin until after the middle of the last century—in the waterworks field early in the eighties; in the electrical, gas and telephone fields in the early nineties; and in the railroad field at an earlier time, though the greatest expansion has occurred therein since 1890.

This rapid expansion necessitated a change in the earlier policy of building betterments in considerable measure out of the earnings of the corporation, to the present method of building from the proceeds of large bond issues, which throw the burden of payment in greater degree upon the future users of the service than did the earlier practice. This change brought about serious abuses in the obtaining of franchises and overcapitalization of corporate property during the first decade of this century.

COMMISSIONS CREATED

The natural result followed, in an attempt to control the activities of the corporation, evidenced by the establishment of the Wisconsin Railroad Commission in 1905, the New York Public Service Commission in 1907, the California Commission in 1911, the Pennsylvania Commission in 1913, the Indiana Public Utilities Commission in 1913, although the Massachusetts commission had been in operation for many years before the establishment of any of these.

There followed a period of corporation baiting and the passage of many laws making the operation of the corporations, and more particularly the maintenance of good efficiency and esprit de corps, very difficult to them.

The railroads particularly have continued to suffer acutely, as evidenced by the statement last year of Howard Elliott, formerly president of the Northern Pacific Railroad, now chairman of the board of directors of the New York, New Haven & Hartford Railroad, before the annual meeting of the Chamber of Commerce of the United States. Mr. Elliott said: "Whatever the reasons for the malady of the railroads, two facts stand out prominently in the history of the railroads of the United States for the year 1915. One is that less mileage was built in that year than in any year since 1864. There have been only three years since 1848 that there was a smaller mileage of new railway constructed than in 1915. The other fact has to do with the amount of railway mileage in the hands of receivers in 1915. With only one exception, 1893, was the mileage, that entered into the hands of receivers, larger than last year, and 1893 was a panic year." And this was in spite of good crops of recent years and great activity in certain sections of the country due to war orders.

Further evidence of these influences is to be found in the recent advocacy by President Wilson, and enactment by Congress, of the Adamson railway bill, granting ten hours' pay for eight hours' work to railway engineers, conductors and others, subject to review hereafter by a commission to be appointed by the President, and to the possible increase in rates, if economies to be effected by the railroads shall not otherwise offset this arbitrary increase in operating expenses.

CORPORATIONS IN FINANCIAL STRAITS

Similar experience has developed in the Far West in the State of California, where from one cause or another, acts of the corporation on the one hand, or on the other hand of the commission, or other public representatives, a large number of public service corporations are at present in financial straits. Among these might be mentioned the Peoples Water Company, the Spring Valley Water Company, the Western Pacific Railroad, the San Francisco-Oakland Terminal Railways (Key Route System), the Oakland-Antioch & Eastern Railway, the West Sacramento Land Company, the Oro Electric Corporation (Electric Light, Power

& Water Supply Co.), the Cuyamaca Water Company, the Pacific Gas & Electric Company, the San Francisco Telephone Company, and a number of others. In the East and Middle West there are many similar examples.

But to-day there are already evidences of better conditions and that the pendulum is swinging again toward its middle position. The management of our great public utilities is cleaner and better for the agitation. The rights of the public are to-day recognized quite as clearly as are those of the corporation. Indeed, a spirit of toleration and effort to court the favor of the public has been developed on the part of the corporations probably to a greater degree than on the part of the public service commissioners and the public, for it is an unfortunate fact that some of the public representatives still appear to regard themselves as advocates of the public interest, rather than as impartial judges—between the interests of the public and the corporation—and it is unfortunately still true, and is likely to continue to be true under American political conditions, that political pressure is felt by the commissions as well as by the corporations. Here, too, however, conditions are improved over those of a decade ago.

THE PRESENT OUTLOOK

In the view that regulation by commission is probably the best solution of current issues between the corporations and the public, it may be of interest to review the present outlook, in its broader aspect, after a decade or more of commission control.

What do we mean by control of the public utilities by public service commission? The effort to so regulate the conditions of service and the financial return as to assure the public good service at fair price, and to the corporation a reasonable return upon the fair value of its property devoted to public use.

This involves the determination by the controlling or regulating body, first, of the fair value of the property; and, second, the equitable rate of return upon it, commensurate with the hazard involved by the business.

BASIS OF COMMISSION CONTROL

The prescribed or existing conditions must be such as to attract capital to the rendering of these services, which the public, for one reason or another, has not cared to undertake for itself. In this connection a clear distinction must be made between natural monopolies, such as waterworks, electric or gas plants, and the competitive enterprises, such as the railroads.

Two methods of operation are possible—first, the guaranteeing to the corporation of fair return upon its actual investment, with the lower rate of return commensurate with this guarantee; second, forcing the company to bear the hazard incident to the investment and giving to it a higher rate of return, commensurate with this hazard and with the fair value of the property devoted to the service of the public.

The higher courts have constantly adhered to the second principle, ruling that original cost was of significance, but not necessarily of controlling importance; that reproduction cost as of date of valuation was of importance, particularly in the case of old properties; and that consideration should be given to the value of the securities, to the worth of the service to the consumer, and to any other matters which might seem to have probative force in fixing value.

The controlling commissions have, unfortunately, not always followed the precedent of the court, but have sometimes tended strongly toward the measurement of values practically by original cost, even excluding from the latter those elements of cost carried by the operating account, regardless of the question as to whether a fair return was earned contemporaneously with the payment of these costs. They have sometimes excluded certain elements or so-called increments of value, recognized by the courts; and have attempted to make the corporation carry the burden of the hazard of the business on an allowed rate of return commensurate with an implied guarantee, instead of with the actual hazards of the business.

REGULATION VERSUS OPERATION

There has been ground for anxiety lest the commissions should go so far as to attempt to dictate policies rather than simply to control or limit the activities of the corporations. In the main, however, the commissions have wisely limited themselves to the functions of a regulating body, upon the theory that it is safer to leave to the executive officers of the corporations—who are accountable not only to the owners of the property but also to the regulating commission—the determination of policies of operation, leaving the commission to sit in review upon the results obtained under them, rather than for the commission to determine those policies. If the commission is to dictate operating policies it must, in all fairness, assume full responsibility for them and relieve the corporation management of the hazard element involved, thus in effect guaranteeing revenue and operating conditions to the corporations, as would ultimately be necessary under such a theory of public administration.

The public has clearly manifested its preference for *regulation* by commission, of corporately-operated public utility property, rather than public or commission *operation* of such public utility properties, under the past and present conditions prevailing, and the future conditions likely to develop in the United States. Thoughtful observers see grave danger in the extension of the functions of the public service commission to the determination of the details of operating policies and practices, as well as to the broad problems of character of service, fair return, and equitable distribution of the burden of rates, unless the commission can be divorced from politics and be given far greater financial support and unless the hazard of operation be assumed by the public—all of which will certainly involve a serious change in policy and a final cost of service to the public likely to be substantially greater than that under private operation and public utility commission control of such properties.

REQUIREMENTS OF VALUATION

The fair valuation of large properties, having diversity of interests, is not a simple, but a highly complex matter. It is dependent upon:

1. Experience in the design, estimate of cost, construction, and operation of such properties.
2. Imagination, tempered by judgment.
3. Intellectual honesty and logical mental habits, the ability to determine causes and their effects, and the relative importance of different facts.
4. Knowledge of men, ability to work with them, and to be able to draw out information.
5. Technical knowledge and skill.
6. Character and judicial temperament.

THE STEPS IN VALUATION

Think for a moment of the steps in valuation of the property of public utilities. The trained mind does not think in formulas, but goes unconsciously straight to the heart of the matter, determines and faces the facts. If the facts be stubborn and do not fit preconceived theories, it reconstructs its theories but never blinks at the facts. Intellectual honesty and good morals demand this.

First, the imagination is called into play, picturing the historic conditions and the probable present day conditions under which the works have been or might be built and developed, in accord with available records of the past and the probable present conditions incident to the reproduction of the property.

Then the inventory of the property is prepared, requiring extreme care and technical knowledge of design and methods of construction.

Next the unit prices and overhead costs are applied to the inventoried quantities, involving thorough knowledge of cost, methods of construction, and careful study of local conditions and limitations—if the valuation is to be fair and not purely academic. It is here that the evaluator is at the greatest disadvantage, if he has not had breadth of actual experience in construction, for he is liable otherwise to seriously underestimate the difficulties and hazards to be encountered, and the collateral or incidental costs involved, as every man who has had breadth of construction experience in large corporate works, or who, perchance, has built himself a house, appreciates full well.

INTANGIBLE VALUES

Then comes the much more difficult determination of the so-called "intangible," though real, elements of value—the franchise, water rights, cost of developing the business, and other similar elements; a study of the financial elements involved; and so the final determination of fair value of the property and fair rate of return to be allowed upon it, in the light of all the pertinent facts.

As the construction and building up of such properties involves the work and cooperation of the promoter, the financier, the engineer, and the operator, for the development of the highest efficiency and accomplishment of the best results, so the valuation of the property at a later day involves, on the part of the evaluator, the qualities heretofore mentioned, coupled with much hard work, discrimination, open mindedness and judicial viewpoint. If the evaluator plays the roll of advocate instead of judge, and limits himself always to developing the viewpoint of one of the parties at issue—whether the public or the corporate—he is likely soon to acquire mental bias. At the upper end of the line we have the true expert, or man of experience in the particular subject under discussion, who strives to develop the facts honestly and with open mind, and then to interpret them judicially. At the other end of the line, we have the equivocator, the smart Alec and the political trimmer. The former is a man of character, most valuable to the public; the latter a mere breeder of discontent and further trouble.

Members of regulating commissions and their engineering staffs are open to the same dangers in the field of valuation as are financiers, engineers, and operators, who testify for the public or for the corporation, in valuation or rate proceedings. The external pressure brought to bear upon them politically, through the newspapers or by individuals, is quite as dangerous as that of the officers or employees of the corporation; and the need of sturdy independence of character is equally essential.

THE PUBLIC'S ATTITUDE

The results of commission control reflect in general the attitude of the public and the body politic—the breadth or narrowness of view, the experience or lack of experience, the force and independence of character or yielding to expediency and political pressure of the commissioners themselves; the frankness, candor and honesty of the corporation officials, or the reverse.

The commissions have in certain respects rendered very important service. They have brought about a more wholesome publicity, have prevented the abuse of serious inflation of values, in some cases have tended to stabilize values and give greater security to property, and they have compelled a just recognition by the corporation of its obligations to the public. In some other respects they have not infrequently failed—to wit, in underestimating the value of public-utility properties, in arrogating to the public enhancements in value or elements of value granted to the corporation as well as to the individual by the highest court, and in prescribing or limiting rates to a return which shows no substantial margin of profit. When they have failed, it has generally been due to lack of breadth of experience and familiarity with such problems, but unfortunately, also, sometimes due perhaps to political pressure or ambition and the playing of the rôle of public advocate rather than that of judge. While the extenuating circumstances have often been great, the public responsibility large, the results have been none the less injurious to or subversive of the highest and most efficient standard of service by the corporation.

GOOD SERVICE THE MAIN ISSUE

There can be no doubt that the intelligent and fair-minded public is far more interested in having good, prompt and up-to-date service at a price yielding a fair or even liberal profit to the corporation rendering it than it is in the slight reduction in cost of service to the public, which may mark the turning point between a fair and an inadequate profit, or between profit and loss to the company.

Thus in the waterworks field who can doubt what would be the answer of the average man were he asked, "Would you rather have your present inadequate service or pay 20 cents more per month for your family service, which is equivalent to 40 cents more per capita per year for a thoroughly good service?" And yet this 20 cents per month increase would mean 1 per cent more or less increase in annual revenue or return to the corporation and might well mark the difference between good credit and bad. Moreover it is to be noted that the corporation is twice penalized if the commission fails to permit adequate earnings, first, in the reduction of revenue, and hence return upon the fair value of the property; and, second, by its resulting inability to borrow money so closely to the market as when it is earning a return which shows profit—for the market exacts interest rates commensurate with hazard and with the available protective margin of earnings.

For instance, the corporation may borrow money upon its bonds at a 5 per cent rate, if the bonds cover but one-half to two-thirds of its property value; at 6 per cent or more if they cover three-fourths to seven-eighths of its value; and at yet higher rates if the bonds equal the property value. In fact the corporation may not be able to market its bonds at all under the latter conditions. The allowing of a fair margin of profit is not only necessary but advantageous to the public.

INITIATIVE STIFLED

It is the consensus of opinion that the commissions have rarely given tangible reward to superior management, that they have found no substitute for the incentive of extra profit and that they have too often limited or reduced the revenue upon the property to a return which shows no profit and no inducement to superior management, with the result of a declining service, a declining market value of the corporation's securities, or even of loss of market, and final inability to borrow at previous rates. Such conditions cannot be justified by any temporary saving in rates to the public or to the individual, for the ultimate cost of the service is actually increased by such drastic treatment and the day of reckoning always comes. No individual, no commission, no court can long dominate money rates. Economic conditions ultimately control, and the lowest rates follow the fairest and most stable conditions of service.

The unfair claims by corporations of enormous franchise and intangible property value have brought their own reward—great shrinkage in these claimed values. The investing public, as well as the court, has discounted these claims.

VALUE OF ESTABLISHED BUSINESS

On the other hand, the failure of some of the commissions to give adequate recognition to the difference in value of the property with established business, as compared with one without it, and to permit rates of return showing profit as well as interest allowance, is also being discredited. The business man, the operator and the financier have always recognized this substantial enhancement in value of the property growing out of the developed business. The investor has always willingly paid for it. The highest court has long admitted it. Broadly speaking, it is only the commissions that have failed to make adequate financial allowance for it. Moreover, they have often failed to permit the earning of revenues which would show a return, including interest and profit.

Examples of the evil results of unreasonable regulation are not lacking. Note the present selling price of and return upon the stock of the Boston Elevated Railway, long under state commission control, the stock of which has been issued and sold for many years past at rates prescribed by the commission, much of it above 125, now selling at below 80, and the corporation obliged to plead for higher return to enable it to borrow funds necessary for extension and betterment of the property.

The Denver Union Water Company, victorious in its recent rates suit before the federal court, which declared confiscatory the city ordinance reducing rates 20 per cent, which ordinance was based presumably upon the Public Utility Commission's determination of the value of the property, which value was substantially doubled by the federal court.

The Spring Valley Water Company fair suits of 1903 and 1905 were won by the company, as were those of 1908-1915 recently concluded after ten months of nearly continuous trial, now awaiting the decision of the Federal Court for the District of Northern California. While this company was not until recently under the jurisdiction of the California Railroad Commission its rates have been subject to annual review and determination by the city's representative, the Board of Supervisors.

RICHMOND DECISION IN INDIANA

The Richmond decision of the Indiana Commission, subsequently revised by the commission itself, and the Terre Haute decision, both reduce the returns to a point adverse to public policy. This result is evidenced by the commission's own subsequent action in raising the revenue first allowed by it to Richmond. The Terre Haute company finds itself in financial straits, for it is unable to raise money for necessary construction and is compelled to suspend the payment of dividends to raise the needed capital. Dow R. Gwinn, president of the Terre Haute Waterworks, is known and respected by waterworks men and engineers the country over. The commission itself admits his good management and fair-minded point of view. Yet the commission has taken action which has seriously endangered the high character of the service which this corporation can render to the public. It is but fair to admit that the effect of the reduction in rates by the commission was rendered more burdensome by the contemporaneous change by the company from a flat-rate to a meter basis of selling water. But this only gives further evidence of the hazard which the commission took in fixing too low a minimum monthly meter-rate—an unnecessary hazard, as the commission could have fixed a tentative monthly minimum rate to make absolutely safe this transition from flat to metered service basis, reducing this minimum by progressive steps as the actual developments might have made possible.

CONTROL IN HANDS OF COMMISSION

The control of the situation was and still is in the hands of the commission, and therefore it may fairly be held responsible for the present deplorable situation. It is believed that the commission itself deeply regrets the situations which have developed both at Richmond and at Terre Haute, and these cases are specifically cited merely to bring home the lesson that it is not to the advantage, indeed it is to the distinct disadvantage, of the public to have the commission rule so closely in its decisions as to incur such hazards. The good faith of the commission is not challenged—merely the wisdom of its action from a public point of view.

Has not the reported "saving to the public" been derived at the expense of the character of service, possible in the long run, and of fairness to the company? At least, the present financial standing of the company has been impaired and the attractiveness of investment in such properties in Indiana reduced. Time will show whether the action is not more far-reaching and of greater import as a problem in policy in control. It seems highly probable that a more liberal policy would have better served the public and the state.

COST OF LITIGATION

The cost of litigation resulting from the commission's extreme action is also to be borne in mind. The commission cannot play the public advocate and then say that the corporations are safe in its hands. The action of the public at Denver, adjudged unfair by the federal court, has involved an unnecessary aggregate cost of upward of $500,000 to the parties at issue. The San Francisco action entails probably $750,000. The expenses of inventory, valuation and litigation are rarely less than $25,000 even in the smaller cities. Such large expenditures yield better returns in structures than in legal battles. Moreover, it is very important to note that it is the public which ultimately has to pay these costs. As the federal court has said, in a recent California waterworks rate decision, though the expenses of such suits be excluded in determining the question of confiscation, they have unfortunately been incurred so frequently of late that they must be given consideration in fixing the fair return. The fair return must be raised to accord with the increased hazard of having to contest such suits and to meet the costs involved. The judge was a man of broad experience as well as a fine jurist, and he knew that this was the view of the business world and of common sense. Therefore the commissions should be prudent and conservative in action in the public interest.

THE REMEDY

These are the remedies:

On the part of the public better compensation, longer tenure of office and freedom from political control of the commissions and their staffs.

On the part of the commissions, greater liberality in their determination of value, and the fair rate of return—a return which will *in fact* recognize the necessity of giving *profit*, as well as mere interest upon investment, and which shall encourage and offer substantial inducement to and adequate compensation for superior management; conservatism in applying new rate schedules, making the changes step by step, and fixing safe tentative minimum monthly meter rates for the transition from flat to metered rate basis of selling water, lest the prescribed rates fail to yield the reduced return fixed by the commission; and finally a sound and fearless stand on the use of meters to their economic limit.

On the part of the corporations candor and frankness in their relations with the commissions, more careful accounting and record of property and costs. Take the commissions into your confidence, rather than hold them at arm's length. Be reasonable and recognize the difficulties of their position and that of their staffs. Play fair and let the facts prove your case, and then fight for fair treatment, if injustice be done. Under such conditions only—possible though difficult of attainment—can a permanent solution of vexatious present problems be reached.

Surges for 16 Miles from Pedro Miguel Lockages

Maximum Oscillation Observed at Panama Lock Is 3 Feet, with Time Interval of 45 Minutes Between Extremes

By R. Z. KIRKPATRICK
Assistant Chief Hydrographer, Department of Operation and Maintenance, Panama Canal, Ancon, Canal Zone

SURGES due to lockages through the Pedro Miguel lock in the Panama Canal are registered at San Pablo, 16 miles from Pedro Miguel, and at Juan Mina, 14 miles away on the Chagres River. They pass through the Gaillard cut 9 miles to Gamboa in 20 minutes, but require 25 minutes more to reach Juan Mina. The maximum oscillation recorded at Pedro Miguel is 3 ft., and except when slides have encroached on the canal prism there has been little difficulty in the handling of boats.

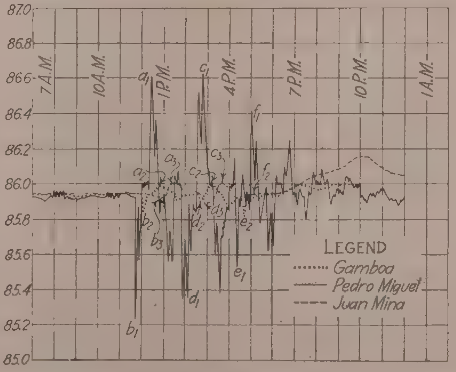
The Pedro Miguel lock is at the south end of Gaillard cut, the narrowest part of the Panama Canal. The cut, with the theoretical bottom width of 300 ft. and the theoretical side slopes, has a cross-section at El. 85 of 13,600 sq. ft. Due to removal of slides, a larger area occurs at some sections. The banks of the cut are rock and earth.

HOW THE LOCKS ARE FILLED

The twin chambers are filled through culverts in the walls, one to a wall. Each culvert has a minimum area of 255 sq. ft., and is controlled by two Stoney gate valves, with a clear area of 288 sq. ft. A chamber is 1000 x 110 ft., and requires more than 3,000,000 cu. ft. of water in locking a boat up from the Miraflores Lake to the Gatun Lake level. It takes from 7½ to 8 minutes to draw this water, using side and center wall culverts. When the side-wall culvert alone is used, the time is 13½ minutes. It is found that the lock chambers fill at nearly a uniform rate, after the valves are opened. In filling both chambers about 13,000 sec.-ft. is drawn, which would give 0.95 ft. per second velocity in the cut, if water were supplied as fast as drawn. To cut down this velocity the canal above the lock was made 600 ft. wide, narrowing down to 300 ft. at a point 3400 ft. north. The resulting basin acts as a reservoir for the first part of a draft of water.

SURGES LAST HOURS

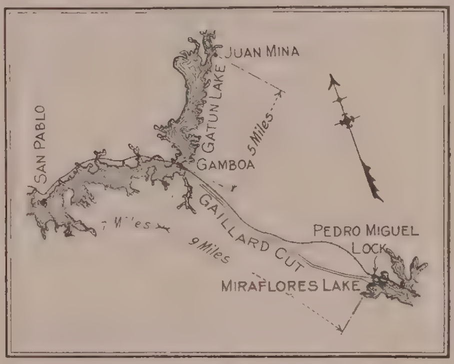
The surges resulting are interesting. The sketch plan illustrates the positions of the surged areas. The vertical oscillations occur for hours, being felt as far as the Juan Mina and San Pablo hydrographic stations. A draft of water is felt at Gamboa, through 9 miles of still water, in 20 minutes. It takes 25 minutes longer to be felt through the 5 miles of current up the Chagres River of the lake to Juan Mina. The succeeding crest of the surge, at all stations, is 45 minutes after the trough of the surge at that station.



HYDROGRAPHS AT THREE POINTS SUPERIMPOSED FOR A DAY OF THREE LOCKAGES

The superimposed Pedro Miguel, Gamboa and Juan Mina hydrographs show conditions resulting from the up lockages of the steamships American Transport, Crickett and Lewis Luckenbach on Nov. 7, 1914. Points b_1, d_1, and e_1 on the Pedro Miguel hydrograph, b_2, d_2 and e_2, Gamboa, and b_3 and d_3 at Juan Mina show effects of drafts for the ships in the order named. Likewise a_1, c_1, f_1, etc., show the resulting surges or overtravels. It is noted that a Chagres River freshet, starting about 6.15 p. m., obliterated any effect at Juan Mina due to the lockage of the Lewis Luckenbach.

The observations made since canal operations began appear to show facts as in the following discussion: When the valves are opened to fill a lock chamber the basin above the gates becomes depressed, the extent of the lowering depending on the number of valves opened and the size of the resulting openings. This depressed water surface causes a surface current in the canal toward the lock that continues until an elevation is reached that is as much above the initial level as the depressed elevation was below. The surface current and wave amplitudes continue for some time with decreasing intensities.



PART OF PANAMA CANAL SURGED BY PEDRO MIGUEL LOCKAGES

HARMONIC ACTION PROBABLE

It is probable that harmonic action increases or decreases the currents and amplitudes; that is, if a new draft of water should make a depression in phase with a secondary trough of a wave from a previous lockage, the resulting oscillations would be unusually large. It is fortunate for shipping that the doctrine of chance nearly always decrees that the oscillations from repeated lockages are partly antagonistic, thereby cutting down these wave amplitudes, with their resulting surface currents.

Except in times of partial closure of the prism, these surges have given little trouble in handling boats. When a cross-section was cut down by a slide, it was necessary to draw water at Pedro Miguel very slowly or not at all while boats passed the restricted portion.

Thus far the Pedro Miguel water-stage instruments have shown no surge amplitude of more than 18 in., or a total oscillation of 3 ft., and there is ordinarily 45 minutes of time between the extremes of the fluctuations.

Tests Apparently Substantiate the Theoretical Formula for Strength of Outstanding Flanges

Results of Experimental Investigation Presented and Discussed to Show Effects of Distribution of Metal in Column Sections

By RAYMOND J. ROARK
College of Engineering, University of Wisconsin, Madison

IN AN article entitled "Strength of Outstanding Flanges in Beams and Columns," published in the Engineering Record of Dec. 27, 1913, page 722, the writer proposed a theoretical formula for the elastic buckling strength of flanges in compression. It was appreciated that, lacking experimental verification, the formula could only be regarded as tentative, and the necessity for substantiating tests was recognized. A number of such tests have recently been made by the writer, and it is the purpose of this paper to present the results obtained and to discuss these results in conjunction with the theory previously developed.

ORIGINAL ASSUMPTION REVISED

It was assumed in the original analysis that the elastic curves of the hypothetical vertical and horizontal strips were parabolic. Perhaps a more nearly correct assumption is that each vertical strip bends in the sine curve indicated by Euler's theory, and that each horizontal strip assumes the curvature of a cantilever beam under triangular disposition of load. If the analysis is made on the basis of such assumption, it is found that

$$p = Et^2L^2/9.35b^4 + \pi^2Et^2/12L^2$$

This gives a minimum value of p when $L = 1.66b$, and substitution of this value gives the equation

$$p = 0.6Et^2/b^2$$

in which p is the unit load in pounds per square inch, causing the elastic buckling of the flange; E, modulus of elasticity of the material in pounds per square inch; L, length in inches of that portion of the flange over which bending in one direction extends; t, thickness in inches, and b, width in inches, of the flange.

INSTRUMENTS ATTACHED TO SPECIMEN

In the original analysis the formula for minimum strength was

$$p = 0.65Et^2/b^2$$

for $L = 1.60b$.

TEST PIECES AND METHODS OF TESTING

Two series of tests were made, those of the first series on columns of T-section, each consisting of a wide plate with angles riveted along one edge. The dimensions and details are shown in Fig. 1. These specimens had their ends ground to an even bearing and were tested in the 600,000-lb. hydraulic machine in the laboratory of the University of Wisconsin. Loads were applied in increments of about 5000 lb. per square inch, and the corresponding strains at the free edge of the flange measured over two 2-in. gage lines with a Berry strain gage.

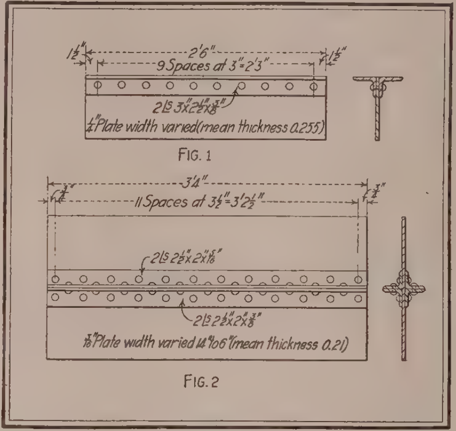


FIG. 1

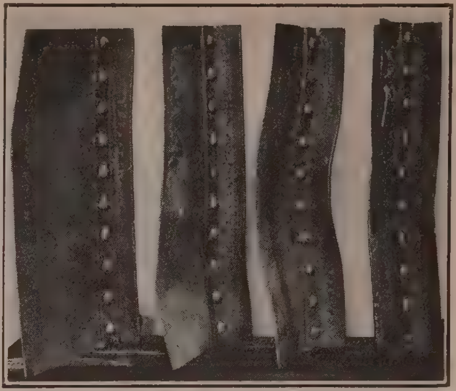
FIG. 2

FIGS. 1 AND 2—DIMENSIONS OF SPECIMENS

It was found that up to a certain unit load the strains increased proportionately to the load. Beyond that point the flange began to bend visibly, and the strains either remained constant or decreased slightly. The stress corresponding to the maximum observed strain was in each case taken as the buckling strength of the flange. When the test had been carried far enough to determine this buckling strength, the load was applied continuously until the specimen failed, and the ultimate load and manner of failure were noted. The results of this series of tests are given in Table 1.

The second series of tests was made on a short column of star section, consisting of a wide plate with four angles riveted along the center line. This test piece was designed to give a greater range of values of the ratio b/t than had been obtained with the T-sections. Its dimensions are shown in Fig. 2.

Loads were applied in increments of approximately 1000 lb. per square inch, and strains measured over 10-in. gage lines on each flange edge by means of wire-wound dials extensometers reading to 1/10,000 in. Two dials, placed equidistant from the plate, were used on each edge to eliminate errors due to bending. Upon reaching the point at which the strains no longer increased with increased loading, the load was removed, a new zero reading taken, and the test repeated as a check. The specimen was then taken from the machine, the width of the flanges reduced by cutting a 2-in. strip from each edge of the plate, and the specimen retested. The results of this series of tests are given in Table 2.



TYPICAL FAILURES OF T-SECTION

COMPARISON OF RESULTS WITH THEORY

The graph of the equation $p = 0.6Et^2/b^2$ is shown in Fig. 3. On the same figure are indicated the points corresponding to the observed strains in the specimens tested. For the first series of tests the stresses plotted were found by averaging the maximum unit strains measured on any one specimen over the two gage lines, and multiplying this average by 30,000,000. In all cases but one the measurements over the two gage lines agreed closely; in that one instance only the more consistent set of readings was used, the other evidently having been vitiated by flaws in the drill holes.

For the second series of tests the stresses on the north and south edges of the plate were computed separately. Here again the maximum unit strain multiplied by 30,000,000 was taken as the buckling stress. In two instances (when $b/t = 67$ and when $b/t = 29$) results were obtained for only one flange edge. In the first case only one set of dials was attached; in the other case the load was slightly eccentric, and one edge began to buckle before the stress in the other had reached more than 6000 lb. per square inch. It is believed that the results of this second series of tests are more reliable than those of the first, and that more weight should be attached to them.

FAIR AGREEMENT NOTED

It will be noted that only a fair agreement obtains between the curve and the plotted points. It was to be expected that the results would, in the main, lie below the curve. The theory was developed on the assumption that the flange was truly fixed at the attached edge. In these tests the body, or central portion, of any specimen was light and of a form poorly adapted to resist the twisting induced by loading of the flanges. For this reason the horizontal cantilever strips were only partly fixed at the attached edge of the flange, and the support afforded the vertical strips by them was consequently less than the theoretical amount. This is brought out by the fact that, when the load on a specimen was carried beyond the point of the maximum flange stress so as to cause perceptible bending of the flange and twisting of the specimen, the unit stress along the flange edge diminished somewhat.

It is not apparent, at first glance, why certain points should lie above the curve. In the general equation for p, the substitution of cb for L, c being any constant, yields an equation of the form

$$p = KEt^2/b^2$$

where K is a constant depending on c. As has already been shown, p is a minimum when $c = 1.66b$, K then being 0.6. For values of c either greater or less than 1.66, K increases, showing that p becomes greater when flexure in one direction extends over a length of the flange either less or greater than 1.66 times the width. The nature of this variation is shown clearly by the curve, Fig. 4, obtained by plotting values of K against corresponding values of the ratio of length to breadth of bent flange.

In the first series of tests the length over which bending of the flange took place was not measured. In the second series of tests, however, this length was measured. In the test where $b/t = 57$ the north edge of the plate bent in a reversed curve, and bending in one direction occurred over a length of about 20 in. The south edge, however, bent in the same direction over its entire length, or 40 in. The width of the flange was 12 in., so that the ratio of L to b was 3.3, and from the curve of Fig. 4 the corresponding coefficient K is seen to be 1.3. Hence the theoretical stress becomes 1.3/0.6 times the value indicated by the graph of Fig. 3, or about 12,000 lb. per square inch. The observed stress was less than this, probably because of the twisting of the column. In the test where $b/t = 48$, both edges bent over lengths of about 18 in., but in the next test, where $b/t = 38$, the south edge again bent in the same direction over its entire length, and showed a high buckling strength. This tendency was probably due to a very slight initial curvature, or to a small unevenness of the bearing surfaces. The high values obtained in the first series of tests are probably similarly explainable, and it seems therefore that all the experimental results are really lower than the theoretical values.

TABLE 1—TESTS ON T-SECTIONS (SERIES 1)

Number of Specimen	Area of Cross-Section, Sq. In.	Breadth of Flange, In.	Ratio of Breadth of Flange to Thickness, b/t	Unit Stress at Edge of Flange When Buckling Occurred, Lb. per Sq. In.	Average Unit Load on Specimen When Buckling Occurred, Lb. per Sq. In.	Total Load at Failure, Lb.	Unit Load at Failure, Lb. per Sq. In.
A1	5.13	3.56	14	35,700	38,500	222,500	43,500
A2	5.13	3.56	14	26,800	39,200	214,000	41,700
B1	5.90	5.37	21	30,700	36,700	225,500	38,200
B2	5.90	5.37	21	25,500	30,100	207,500	35,200
C1	6.40	7.50	29	28,300	29,100	201,500	31,500
C2	6.40	7.50	29	24,000	30,000	225,500	35,200
D1	7.01	10.00	39	14,800	19,400	204,000	29,100
D2	7.01	10.00	39	13,000	19,500	221,500	31,600

TABLE 2—TESTS ON STAR SECTIONS (SERIES 2)

Number of Specimen	Area of Cross-Section, Sq. In.	Breadth of Flange, In.	Ratio of Breadth of Flange to Thickness, b/t	Unit Stress at Edge of Flange When Buckling Occurred: North Edge, Lb. per Sq. In.	Unit Stress at Edge of Flange When Buckling Occurred: South Edge, Lb. per Sq. In.	Average Unit Load on Specimen When Buckling Occurred, Lb. per Sq. In.
1	12.44	14	67	2,400	....	4,820
2	11.60	12	57	3,300	7,800	6,900
3	10.76	10	48	4,800	5,550	7,430
4	9.92	8	38	10,650	16,650	10,000
5	9.08	6	29	20,700	....	13,200

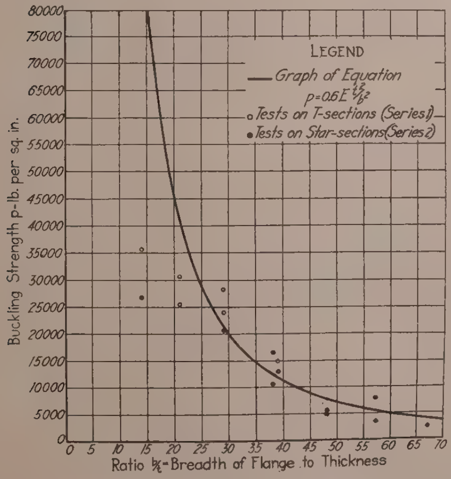


FIG. 3—RESULTS OF TESTS PLOTTED FOR COMPARISON WITH GRAPH OF EQUATION

It will be seen from the data in Tables 1 and 2 that the observed stress in the flange edge is, in most cases, less than the average unit load on the specimen. As the loads were applied in increments of from 1000 to 5000 lb. per square inch, it is evident that an equal discrepancy might exist between the buckling stress and the average unit load. It was impossible, of course, with such wide sections, to secure either an exactly even bearing or a perfectly central loading. In general, the agreement between the flange stress and average stress seems to be as close as could be expected under the circumstances.

MANNER OF FAILURE

The manner of failure of all the specimens of the first series of tests was the same, and was characterized by a gradual bending of the flange, followed by twisting of the body of the member and failure through such twisting. This twisting is shown by the photograph of the specimens after failure. The wide flanges, starting to bend at a comparatively low stress, induced torsion at a lower load than the narrow flanges. As a result, the ultimate unit load is much less for the specimens with wide flanges than for those with narrow flanges; indeed, even the total load appears to decrease as the flange width increases. This shows clearly that the presence of wide unsupported flanges constitutes a source of weakness in columns, and that the factor of safety may be lowered thereby, even though such flanges may carry their share of the load under working conditions. It should be noted, in this connection, that the bodies of the specimens tested were very light, and of a form poorly adapted to resist torsion. The effect of torsion induced by the flexure of wide flanges on columns of heavy section and ordinary design would probably be much less marked.

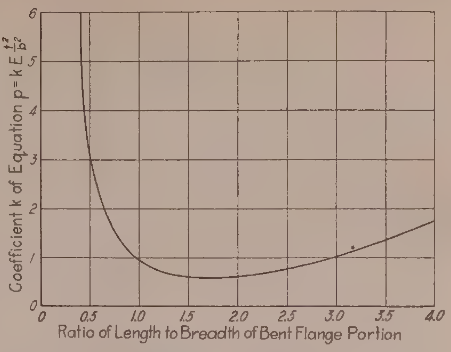


FIG. 4—HOW STRENGTH VARIES WITH RATIO OF BENT LENGTH TO BREADTH

The specimen used in the second series of tests was not loaded to failure, but its behavior under load indicated that it would fail in the same manner as the others. The accompanying photograph of the specimen under load shows flexure just beginning, and this flexure, when carried a little further by increased loading, caused a perceptible twisting.

CONCLUSIONS

The results of the tests appear to warrant the following conclusions:

1. The buckling strength of an outstanding flange, of width b and thickness t, truly fixed at the attached edge, is given approximately by the formula

$$p = 0.6Et^2/b^2$$

2. Flexure in one direction may be induced by initial curvature or eccentric loading over a length greater than that for which the buckling strength is a minimum. In this case the strength of the flange may be considerably greater than that indicated by the formula.

3. If the flange is not truly fixed at the attached edge the buckling strength may be considerably less than indicated by the formula.

4. Under a unit load exceeding the buckling strength an outstanding flange bends, and this bending induces torsion in the member of which it forms a part. Such flanges may thus constitute a source of weakness, and while carrying their share of the load at low stresses render the ultimate strength of the member less than it would be were the flange, or part of it, removed.

All the specimens used in the tests were donated by the Worden-Allen Company of Milwaukee, Wis., whose courtesy the writer takes pleasure in acknowledging. Thanks are also due Dean F. E. Turneaure and Prof. M. O. Withey of the College of Engineering, University of Wisconsin, for suggestions as to the design of test pieces and methods of testing.

Date Set for Completion of Hetch Hetchy Project

Construction work on the Hetch Hetchy water supply project, which is to provide a new supply for the city of San Francisco from Lake Eleanor in the Yosemite National Park, is being rapidly advanced. In a recent discussion on the progress of the work City Engineer M. M. O'Shaughnessy stated that the project will be carried out at such a rate that the water can be delivered to the city in 1923.

Says Oregon Road Laws Need Overhauling

John H. Lewis, State Engineer, Believes Well-Organized Department Is Needed to Complete General Highway System

THAT there is need for a general overhauling of road laws in the state of Oregon, so that responsibility may be fixed upon the proper officers, is the opinion of John H. Lewis, state engineer. In outlining the present organization he says: "We have 105 county judges and commissioners, 35 county surveyors, four roadmasters and 862 road supervisors in charge of the expenditure of from $4,000,000 to $6,000,000 per annum on county roads. Three members of the state highway commission and a state engineer are in charge of the expenditure of $235,000 of state money. In general these men are honest. With a definite plan or policy to work under they would doubtless prove efficient. But they are disorganized. Frequent changes in office and occasional recalls and reorganizations make it very difficult for the public to profit by past experience. Many unnecessary disputes occur between state and county officials because of indefiniteness of existing laws. Valuable time is wasted. Having only limited power and without any substantial policy to adhere to, these state and county officials are dragged around by interested property owners, enthusiastic citizens having pet projects, or by designing contractors and material men. They are forced to spend public money on small, disconnected, hastily considered, inadequately financed, unrelated projects without regard to the larger plans of interest to the whole people.

"There is thus need for a general overhauling of road laws in Oregon to the end that responsibility for road work may be definitely fixed upon officers having adequate powers. Some provision should be made for continuity of effort through a well-organized department for the completion of a general highway system for the state."

One-Fourth of Water Fund Expended

According to reports, $104,000 of the $400,000 voted for the Wishkah water project in Washington has been expended. Most of it was spent for materials, the remainder for clearing, grubbing and actual construction work. Clearing and grubbing of the pipe line right-of-way have cost $262.47 per acre. So far 68.16 acres have been cleared and 25.54 acres grubbed.

ARCHITECTS' SKETCH OF TERMINAL AS IT IS TO APPEAR WHEN COMPLETED

Pennsylvania Freight Terminal at Chicago Striking in Both Size and Appearance

Five-Story Structure Occupying Entire Block and Surmounted by Ornamental Tower Will Be Supplemented by Ample Team and Storage Yards

BOTH in size and appearance the new freight terminal of the Pennsylvania Lines West of Pittsburgh, now well on toward completion, is striking. Occupying an entire city block of about 420 x 740 ft., with the ground level given over entirely to tracks and narrow trucking platforms, and four freight and warehouse floors rising above, it will take front rank in size; while the architectural treatment, including the massive tower, will give it an individuality not heretofore attempted in this country in such utilitarian structures. To make room for the Union Station development (see last week's issue, page 558) it will be necessary for the Pittsburgh, Fort Wayne & Chicago to give up the site of its freight houses in the vicinity of Madison and Adams streets, and it was therefore decided to concentrate all of the Pennsylvania's less-than-carload downtown business in one two-level freight house. The site chosen was south of Polk Street, between the present tracks and the Chicago River. The freight house will extend to Taylor Street, and south of that street will be team tracks and storage yards.

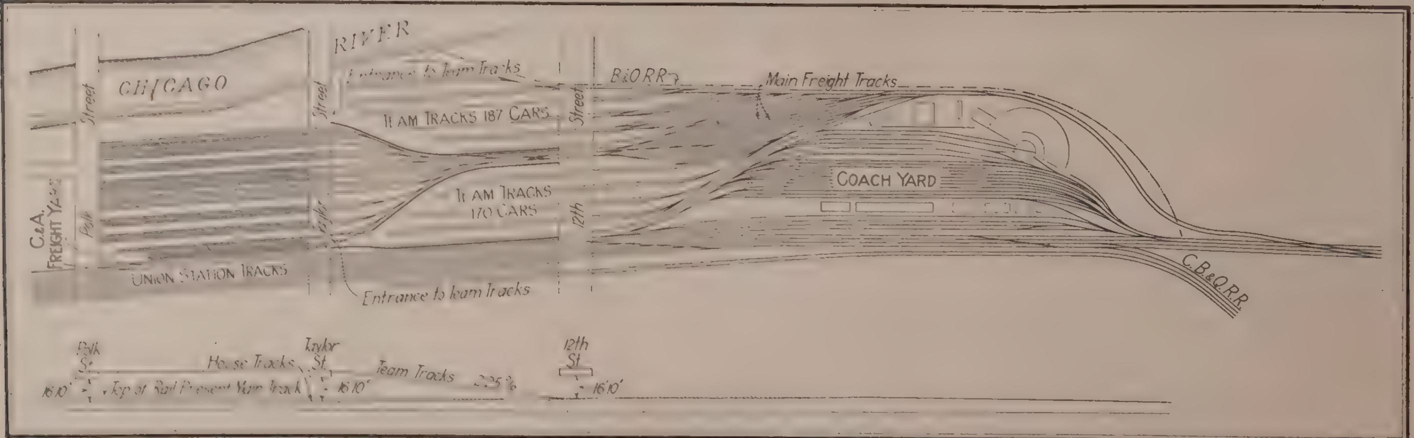
Site Had to Be Acquired

Practically all the land occupied by the freight house and the yards had to be acquired. Where the frame of the freight house now stands was a miscellaneous collection of buildings, including a ten-story warehouse owned by the Chicago Dock Company. Just north of Twelfth Street were the engine house and coach and coal yards of the Baltimore & Ohio. These have been relocated at Robey Street.

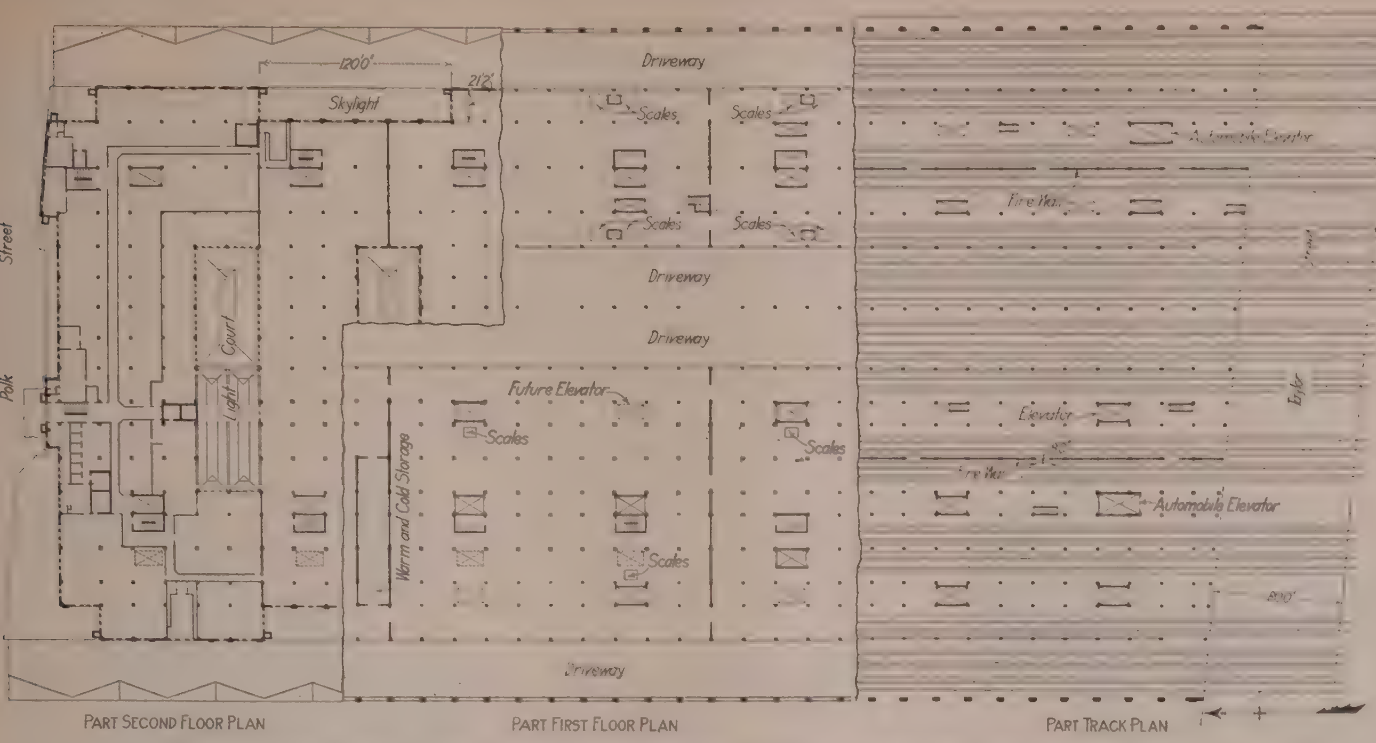
Freight House

The freight house itself is 745 ft. long and 420 ft. wide, and rises four stories above the streets, which pass over the tracks. It has a structural steel frame and brick walls. In the center of the Polk Street end will rise a tower 180 ft. high and about 50 ft. square, with a clock with dials 16 ft. in diameter at the eleventh floor on each of its four sides.

All of the ground level under the building is given over to tracks and trucking platforms. There are fourteen tracks under the building proper, four under the covered driveways on each side of the building, and one additional track on the outside east of the structure—making nineteen in all. The platforms vary in width from 5 ft. 4 in. where they merely separate tracks to 28 ft. where large freight elevators are provided to connect with the upper floors, but in every case there is a platform between tracks so that there will be no necessity for spotting cars to bring doors opposite each other. The platforms extend under Taylor Street, giving a total length of 800 ft. each, except that at the northwest corner, which is encroached upon somewhat by tracks leading to the Chicago & Alton freight yard north



TERMINAL BUILDING OCCUPIES ENTIRE BLOCK—APPROACH TRACKS FLANKED WITH TEAM YARDS RISING TO LEVEL OF TAYLOR STREET



PART SECOND FLOOR PLAN — PART FIRST FLOOR PLAN — PART TRACK PLAN

PARTS OF THREE FLOORS—GROUND LEVEL GIVEN TO TRACKS, INBOUND AND OUTBOUND HOUSES ON STREET LEVEL, WAREHOUSE ABOVE

of Polk Street, three of the house tracks are slightly shortened.

The second floor, or street level, is divided longitudinally by a 72-ft. double driveway, leaving an outbound house 100 ft. wide on the east and an inbound house 171 ft. wide on the west. In addition along the outside of each house is the 36-ft. covered driveway previously mentioned. Transverse fire walls divide each house into lengths of about 200 ft.

The three upper floors will be used for warehouse purposes except at the north end, in which the offices will be located. In the warehouse section the longitudinal wall which divides the street level into the two houses is omitted. Light for the street floor is provided by the system of skylights shown in the building plan. Six interior light courts are carried down to the second floor, the street floor being considered the first, and in addition notches 120 ft. long and 21 ft. wide—two in each side of the building—make four more large skylights possible. Transverse fire walls at each transverse light court divide the warehouse floors into 100-ft. sections.

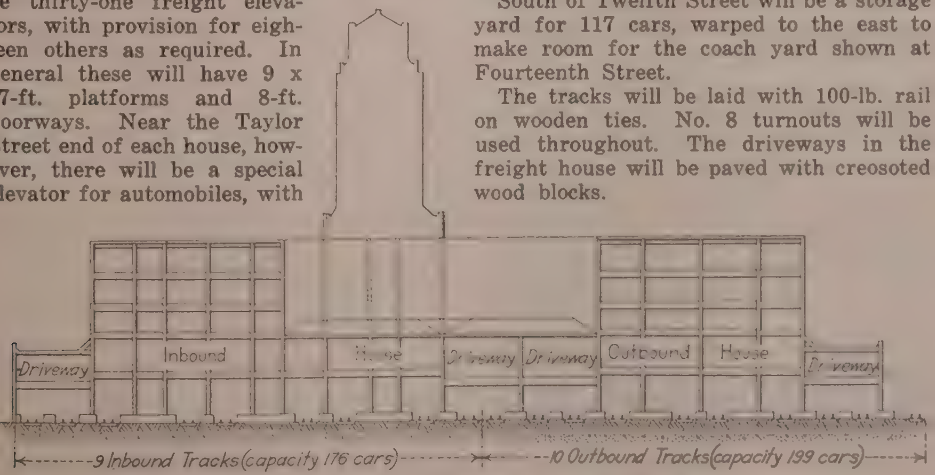
In addition to a passenger elevator on Polk Street to serve the offices, there will be thirty-one freight elevators, with provision for eighteen others as required. In general these will have 9 x 17-ft. platforms and 8-ft. doorways. Near the Taylor Street end of each house, however, there will be a special elevator for automobiles, with 10 x 24-ft. platforms and doorways 10 ft. high. The locations of present and future elevators are shown on the plan.

TEAM TRACKS

The general track plan shows the problem encountered in providing the team tracks. There was not room available for ramps from Taylor Street, the natural outlet of the team yard, to the ground level without a prohibitive sacrifice of costly land. On the other hand, the Twelfth Street viaduct made it necessary to keep all tracks down to the ground level at that point. The only solution therefore seemed to be to raise the entire team yard, both sides of the approach tracks to the freight house, from ground level at Twelfth Street to street level at Taylor Street, and by means of retaining walls hold the fill away from the low-level freight-house tracks and also from the Union Station tracks on the west. This gives a team-track capacity of 403 cars, with 30-ft. driveways between pairs of tracks and between ends of tracks and retaining walls, and two 50-ft. entrances to Taylor Street. North of Twelfth Street the tracks are necessarily on a 2.25-per cent grade.

South of Twelfth Street will be a storage yard for 117 cars, warped to the east to make room for the coach yard shown at Fourteenth Street.

The tracks will be laid with 100-lb. rail on wooden ties. No. 8 turnouts will be used throughout. The driveways in the freight house will be paved with creosoted wood blocks.


Driveway
Inbound
House
Driveway
Driveway
Outbound
House
Driveway
9 Inbound Tracks (capacity 176 cars)
10 Outbound Tracks (capacity 199 cars)

TRANSVERSE SECTION SHOWS ARRANGEMENT OF TRACKS, DRIVEWAYS AND FLOOR SPACES

Motor-Truck Legislation Advocated in Michigan

Bill Restricting Weight, Size and Speed of Trucks Prepared by Wayne County Commissioners

LEGISLATION regulating the use of motor vehicles on public highways is advocated in the 1915-16 report of the Board of County Road Commissioners, Wayne County, Michigan. The following bill has been drafted and its adoption is recommended:

PROVISIONS OF BILL

Section 1—No traction engine, road engine, trailer, steam roller, automobile truck or other power vehicle, the face of whose wheels are fitted with spikes, shall be driven upon public highways in this state which have been improved in whole or in part with the aid of funds of the state of Michigan, paid in the shape of highway rewards by the state to any road district of the state. No such vehicle whose wheels are fitted with flanges, ribs, clamps, cleats, rings or lugs, or any other projection, shall be permitted to use such highways unless such projections are fastened upon all the wheel thereof and are not less than 2½ in. wide and not more than 1½ in. high, and are so placed that not less than two of said projections upon each wheel bear upon the ground at all times and so that the weight shall be distributed equally on all parts thereof. But where such vehicles are used solely in transporting agricultural machinery or products, the following requirements shall apply: There may be a guide band not less than 2 in. wide on the front wheels, in which case no flanges, ribs, clamps, cleats, rings or lugs shall be required. The full set of flanges, ribs, clamps, cleats, rings or lugs furnished upon the rear wheels of such vehicles according to the original design must be used. No rivet heads or bolts shall be allowed to project upon either front or rear wheels.

Section 2—Such vehicles whose equipment does not comply with this act may be licensed by the state highway commissioner to travel upon such highways in cases where coverings of wood or other substance are attached to the wheels in such manner as to present a smooth surface, and in accordance with regulations fixed by the commissioner. No vehicle subject to the provisions of this act shall be equipped with ice picks or mud lugs. No such vehicle which, with its load, weighs over 14 tons shall be operated upon any highway of this state subject to the provisions of this act, unless a license therefor is previously secured from the state highway commissioner. Such license shall prescribe such regulations as are necessary in the opinion of the commissioner for the preservation of the highways. No object which weighs more than 14 tons shall be moved over such highways by means of wheels, rollers or otherwise, without a similar license from the state highway commissioner. No load exceeding 9 tons shall be carried upon any one axle or upon any single roller. Except as herein otherwise provided, the tires of such vehicles shall be smooth and the weight of such vehicles when loaded shall not exceed 800 lb. per inch in width of such tires, except in cases where the carriage of a greater weight is permitted by the state highway commissioner.

WIDTH AND SPEED

Section 3—No such vehicle of greater width than 90 in. shall be operated upon any such highway, except that traction engines having a width of 110 in. may be so operated.

Section 4—No such vehicle weighing when loaded over 4 tons shall be run upon any such highway at a speed greater than 15 miles an hour. No such vehicle weighing when loaded more than 6 tons shall be run on any such highway faster than 6 miles an hour, if it is equipped with iron or steel tires, nor faster than 12 miles an hour if it is equipped with tires of hard rubber or similar substance.

Section 5—In cases where the state highway commissioner is authorized by this act to grant special licenses or permits, he shall do so only upon written application made in such form as he shall prescribe. Such licenses and permits shall be written and shall plainly state the acts which are thereby permitted to be done, shall be issued under such restrictions as the commissioner shall prescribe.

Section 6—The owner, driver, or operator of any vehicle subject to the provisions of this act, and the owner of any object, other than a vehicle operated on or transported over such highway, shall be responsible for all damages to said highways resulting from the violation of any provisions of this act or from the violation of the terms and provisions of any license or permit granted by the state highway commissioner. The amount of such damage may be recovered in an action of trespass on the case by the state highway commissioner, or by the board of county road commissioners of the county in which such damage occurs. The amount of such damage shall also be a lien upon the vehicle or object transported which is the cause thereof.

Section 7—Any person who violates the provisions of this act or who exceeds the provisions of any license or permit issued by the state highway commissioner under this act shall be guilty of a misdemeanor; and upon conviction thereof shall be fined not to exceed $250 or shall be imprisoned in the county jail not to exceed six months, or may be both fined and imprisoned in the discretion of the court.

We also recommend that Section 34, Act 302, Public Acts 1915, be amended so as to include special fees credited to the state highway department, consisting of licenses for chauffeurs, manufacturers and dealers' licenses; duplicate plates lost, or destroyed, and motorcycle licenses be included in the distribution to be returned to the treasurer of each county on the basis of 50 per cent of the amount collected to be used to maintain the highways by the local authorities. During the past year over $30,000 was collected from this source, the major portion coming from Wayne County, and all of it was credited to the state highway department. We feel that it should be treated in the same manner as the amounts collected from registered motor vehicles in each county; and we urge that the proper steps be taken by the board of supervisors to bring this recommendation to the attention of the Wayne County delegation in the state legislature.

Finds Electrolytic Sewage Treatment Little Better Than Lime Alone

Company Orders Tests at Decatur Plant Discontinued and Outfit Dismantled After City Insists on Comparison with Lime Only

By EDWARD BARTOW
Director, Illinois State Water Survey

THE Illinois State Water Survey was invited on July 12 to "co-operate with and assist the city to whatever extent it may feel able to or disposed" in the official tests of the "electrolytic lime" sewage-disposal plant built at Decatur by the Electrolytic Sanitation Company of Illinois. Analyses developed the fact that the purification by treatment with lime alone was greater than that obtained in several of the individual samples treated with lime and electricity.

An outline indicating some of the items to be considered in determining the efficiency of the plant was prepared and submitted to the chemists who were to conduct the tests on the ground. The following items were suggested:

I. Cost of Installation.
  (a) Comparison with cost of installing plants of other types.
II. Cost of Maintenance.
  (a) Power for the mechanical operation.
  (b) Power for the electrolysis.
  (c) Lime and other chemicals.
  (d) Labor.
  (e) Interest and depreciation.
  (f) Disposal of sludge.
    1. Sludge pressing.
    2. Moisture in sludge.
    3. Hauling of sludge.
    4. Land required for disposal.
III. Efficiency of Plant.
  (a) Effect of electrolysis.
  (b) Effect of lime.
  (c) Effect of sedimentation (sedimentation capacity necessary).
  (d) Quality of effluent measured by total residue, organic nitrogen, putrescibility, oxygen consumed, alkalinity (to phenolphthalein and methyl orange).
  (e) Comparison of quality of effluent with reported effluents obtained by other processes.

It was impossible for the Water Survey to obtain data concerning all of the items enumerated. Some have been discussed in the report furnished by the chemists and engineer, but others have not yet been given sufficient consideration. The report shows the estimated costs of installing the electrolytic-lime purification plant, but does not give data showing a comparison of the cost of treatment with the cost by other types of sewage-purification plants, especially plants which might obtain an effluent

ANALYSES OF SAMPLES FROM DECATUR SEWAGE EXPERIMENTAL PLANT
(Chemical Results in Parts Per Million)

Sewage Treated with Electricity and Lime

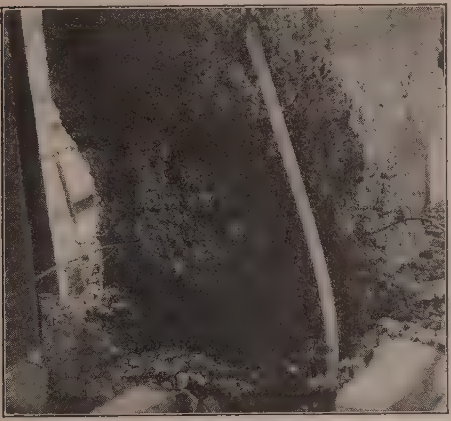
	Nitrogen						Solids											
	Ammonia		Total Organic		Nitrite and Nitrate		Total		Suspended		Dissolved		Alkalinity		Ox. Cons.			Lb. lime per mil. gal.
Date	Raw.	Effl.	Raw	Effl.	Raw	Effl.	Raw	Effl.	Raw	Effl.	Raw	Effl.	Raw	Effl.	Raw	Effl.	Methylene Blue Effl.	
July 24	26.4	12.0	....	...	...	1.0	1,840	1,487	245	62	1,595	1,425	364	146/360	302	185	15 hr. at 20 deg. C.	*
Aug. 4	46.0	11.2	....	...	0.5	0.3	1,515	1,550	460	20	1,055	1,530	460	200/380	164	174	10 min. at 20 deg. C.	3,149
Aug. 11	28.0	12.0	....	...	0.7	0.2	1,505	1,405	190	60	1,315	1,345	440	120/140	160	165	5 min. at 20 deg. C.	3,757
Aug. 19	36.0	14.0	188	82	1.2	1.2	1,970	1,549	291	67	1,679	1,482	320	116/160	350	291	....	3,433
Aug. 20	24.0	12.0	136	76	1.0	1.0	2,830	1,653	517	66	2,213	1,587	320	132/200	390	235	....	2,600
Aug. 20	72.0	15.0	24	75	0.8	1.8	1,537	1,508	165	64	1,372	1,424	520	108/192	212	215	....	....
Aug. 20	42.0	13.0	70	75	1.6	1.6	2,159	1,524	381	40	1,778	1,484	440	96/208	260	270	....	....
Aug. 25	28.0	24.0	....	...	0.32	1.6	1,548	1,417	216	24	1,332	1,393	340	64/324	200	182	Decolorized in few minutes..	....
Aug. 25	28.0	20.0	....	...	0.64	2.0	1,576	1,385	224	20	1,352	1,365	360	80/284	202	186		
Average	36.8	14.8	104	77	0.75	1.2	1,809	1,498	299	47	1,520	1,448	369	118/227	249	211		
Average per cent removed	...	59.8	....	26	...	..	17.2	....	84.4	..	....	4.73	...	42.7	...	15.3		
Sewage Treated with Lime Alone																		
Oct. 6	48.0	27.2	54.4	46.4	1.4	1.1	1,581	1,354	313	26	1,268	1,328	512	124/488	264	178	Decolorized in few minutes..	2,400
Oct. 6	36.8	24.8	41.6	55.2	1.0	0.9	1,436	1,336	198	45	1,238	1,291	468	112/440	260	168		
Average	42.4	26.0	48.0	50.8	1.2	1.0	1,508	1,345	255	35	1,253	1,309	490	118/464	262	173		
Average per cent removed	...	39.0	Increase, 3.8		...	..	....	10.8	...	86.4	Increase, 4.3		...	5.3	...	34		

*Amount of lime from Mariner & Hoskins' report of official test.

of the same quality, as, for example, chemical precipitation with lime.

The Water Survey has also been unable to obtain estimates of the cost of maintenance and can only form conclusions from the results furnished by the chemists and engineer of the company. In these estimates we note especially the high value given to the sludge. We have been unable to confirm the statement through correspondence with manufacturers of fertilizer. It is our belief that the dried sludge containing about 1.6 per cent nitrogen (N) would have little if any value and would probably be disposed of only at considerable expense to the city.

During the official test the plant was visited on five different occasions by Dr. F. W. Mohlman, J. F. Schnellbach and the writer. Samples of raw sewage and of the final effluent were obtained and brought to the State Water Survey laboratory for analysis. At the conclusion of the official test the plant was run for a short time without electricity. One visit was made during this period and samples collected for examination. Additional samples would have been taken when the plant was running without electricity, if the company officials had not ordered the plant shut down.


LOOSE BOARD CONCRETED INTO WEST COLUMN

LIME ALONE BETTER AT TIMES

The results of the analyses have been compared, as shown in the accompanying table. When lime alone was used, less lime was added than on any of the days when lime and electricity were being used. The raw sewage was approximately of the same concentration. That treated with lime alone was weaker than the average if measured in terms of total residue, suspended solids, dissolved residue, and total organic nitrogen, but stronger if measured by ammonia nitrogen and oxygen consumed. The purification by treatment with lime alone was greater than that obtained in several of the individual samples treated with lime and electricity. The alkalinity to methyl orange did not show as great a decrease when lime alone was used, indicating the use of a smaller proportion of lime and confirming the figures obtained by weighing the lime. Measured in terms of oxygen consumed the reduction was greater with lime alone, though in some individual cases greater reduction was obtained with lime and electricity.

COMPANY OBJECTS—QUITS

We regret that because of the objections of the company we were unable to obtain further samples when the plant was running with lime alone. While it is unsatisfactory to draw conclusions from a single test with lime alone, yet the results obtained are better than some of the individual results obtained with lime and electricity. This would indicate that a series of tests would show lime to be as efficient as a combination of lime and electricity. After the test with lime alone the city insisted that there should be a comparative test of one week's duration with lime and electricity and of one week's duration with lime alone.

This test was started on Oct. 23, using lime and electricity. Composite samples were taken to be analyzed in triplicate by the chemist of the company, the city chemist and the State Water Survey. After five days of operation the test was discontinued by the company and the plant ordered to be dismantled. The city will, however, install sufficient apparatus to test the effect of lime on the Decatur sewage.

Poor Concrete in Columns Caused Failure of Bridge

C. B. McCullough Reports Improper Construction as Cause—Laitance, Segregation of Aggregates and Loose Board Found

AN INVESTIGATION of the cause of the failure of a reinforced-concrete highway bridge at Independence, Ore., has recently been reported by C. B. McCullough, of the civil engineering department of Oregon Agricultural College, Corvallis, Ore. Careless and incorrect methods of construction are cited as being chiefly responsible. The more important weaknesses found are the presence of laitance, of segregated aggregates and lack of bond due to excess water and of an embedded board near the base of one column which caused the formation of a pocket of very friable concrete. It is stated that the contractor is in large measure responsible for the faulty construction resulting in failure, and that the county is in a minor degree responsible in not insisting upon careful inspection.

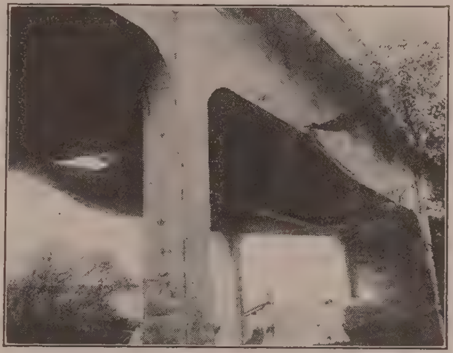
WORKMANSHIP FAULTY

One lesson to be learned from the manner of failure of the 50-ft. girders is the efficacy of shear stirrups in preventing diagonal tension cracks. The following abstracts are taken from the report.

Careful analysis of the design revealed no inherent weakness therein, and no reason is found to blame the cement. While portions of the concrete are lean and friable, other portions immediately adjacent are of much better quality. A sample taken just above the point of failure near the base of the west column developed a compressive strength of 1146 lb. per square inch, about three times the actual unit loading at time of failure. Fine sand was found in some parts of the columns, and the concrete was very lean and porous.

LAITANCE AND STRATIFICATION

Examination of the columns and footings indicates that the latter did not settle, but that the columns failed above the footing, the longitudinal reinforcement being buckled. The concrete at the point of failure in the west column was loose and friable, probably due to the presence of a loose board concreted into it near the base so as to cause the formation of a pocket of considerable size. The load was thus concentrated upon a relatively small sound section of the column. Marked segregation of material, showing sandy streaks interbanded with streaks of rich mortar, was also found. In one spot an analysis showed proportions of 1:17:34. Such a sand pocket could be explained only by improper or careless proportioning or by lack of thorough mixing.


DIAGONAL CRACKS IN WEBS OF 50-FOOT GIRDERS —CRACKS BEGIN WHERE STIRRUPS END

The east column near the point of failure showed complete stratification—a layer of coarse aggregate devoid of finer material, above this a layer of fine aggregate, also very lean, and above this a white chalky material, which is undoubtedly laitance washed to the surface during the operation of depositing the concrete. The bond between aggregate and mortar was everywhere found to be poor, and connected lines of air voids surrounding the stone were very apparent. The concrete was evidently deposited too wet and a film of excess water not forced to the surface by thorough working of the mass had been drawn slowly to the surface and left the aggregate separated from the mortar by lines of connected air voids.

In the conclusions, strong emphasis is given to the fact that the failure was the result of careless and incorrect methods of placing the concrete, and the responsibility is placed upon the contractor and the county, the latter in not insisting upon expert supervision and inspection.

Operates Autos for Less Than 5 Cents a Mile

The thirteen automobiles used by the San Diego (Cal.) operating department covered during the month of September 14,663 miles at an average cost per mile of $0.047. This includes all repairs, tires and tubes, gas, distillate and oil.

Interstate Commerce Commission Makes Its First Two Tentative Valuation Reports

Original Cost Not Found for Atlanta, Birmingham & Atlantic or Texas Midland—No Allowance for Appreciation, Contingencies or "Other Values"

ORIGINAL cost complete is not attempted in either of the first two tentative valuations reported by the Interstate Commerce Commission under the federal Valuation Act. The reports, as announced in the news section of this journal last week, cover the Atlanta, Birmingham & Atlantic Railroad and the Texas Midland Railroad, and are dated respectively Oct. 19 and Oct. 21, 1916. In the case of the former, original cost is dismissed with the statement that it could not be found. Original cost of equipment and of land is given for the Texas Midland. In both reports accrued depreciation is deducted to determine reproduction cost less depreciation, though there is lack of uniformity in the deductions for engineering and some of the general-expenditures accounts. No "other values or elements of value" were found in either property, and there is no mention or apparent allowance of appreciation, contingencies or working capital—or of development expenses or going value, which the carriers have sought to have included in the "other values or elements of value." No allowance is made for land other than the market value of contiguous land.

Parts of both reports, as well as parts of reports on several other carriers, have been in the hands of the carriers for several months, and were in fact discussed at informal conferences between the Division of Valuation and the carriers concerned in June. These partial reports, as well as some of the carriers' comments thereon, were printed by the general secretary of the Presidents' Conference Committee, Thomas W. Hulme, Philadelphia, and distributed among the carriers. The committee has distributed the reports of Oct. 19 and 21 in the same way.

Atlanta, Birmingham & Atlantic

The report proper on the Atlanta, Birmingham & Atlantic, as printed by the Presidents' Conference Committee, has fifty-three pages. The property comprises 641 miles of operated line, including 15 miles leased from the Georgia Terminal and the Alabama Terminal Railroad. The report gives tabulated statements of the reproduction cost new, reproduction cost less depreciation and present value of land of the whole property allocated as to corporate ownership and of the individual properties allocated as to primary accounts and as to states. It also gives a general description of the property, and discusses briefly the physical conditions relating to construction; economic conditions relating to traffic; corporate history; development of fixed physical property; history of capital financing, increases and decreases in securities in any reorganization; aids, gifts, grants and donations; results of corporate operations; investment in road and equipment, and numerous other subjects, both for the main company and for the terminal properties.

The engineering report presented to the carriers earlier in the year sets forth the program for reproduction and explains the bases for unit prices and other figures adopted. The accounting report of 68 pages deals mainly with the corporate history of the property, including that of the related companies. The land report contains only 11 pages; it classifies the lands in various ways, and then explains briefly how the land was appraised.

REPRODUCTION TOTALS

The property was valued as of June 30, 1914. As stated in the note in last week's issue, the estimated reproduction cost new on that date, exclusive of land, is $24,154,998 and the present value of the land is given as $2,291,413. Depreciation to the extent of $4,746,188, or approximately 20 per cent, is deducted from the road, equipment and general-expenditures accounts to obtain reproduction cost less depreciation, giving a total of $19,408,810 exclusive of land.

Reproduction cost new plus present value of land, as given by the commission, is $26,446,441, which may be regarded as the commission's total for reproduction cost new. This compares with an outstanding capitalization of $54,571,176.14 for the Atlanta, Birmingham & Atlantic Railroad alone, the two terminal companies being capitalized for about $9,500,000 and there being in addition outstanding receivers' certificates amounting to $4,994,000, for which the three companies were jointly liable. This gives a capitalization per mile of the main company of $86,296, and a total reproduction cost new per mile of line operated of $41,258, or, excluding the terminals, $37,860.

Jan. 1, 1909, the main property, and the following month the terminal companies, were placed in the hands of a receiver, and have so continued to the date of valuation. For the eight years and two months from May 1, 1906, to June 30, 1914, the report shows a net loss from operation of $4,446,695.25. No dividends have been paid.

TABLE 1—REPRODUCTION FIGURES FOR CERTAIN PRIMARY ACCOUNTS, ATLANTA, BIRMINGHAM & ATLANTIC RAILROAD

Class	Reproduction cost New	 Less depreciation	Depreciation deduction, per cent
Road:			
Engineering	$569,503	$569,503	0
Grading	5,263,885	5,254,891	0.17
Bridges, trestles and culverts	2,370,720	1,980,705	16
Ties	999,281	508,347	49
Rails	2,717,804	2,400,600	12
Ballast	381,770	278,343	27
Tracklaying and surfacing	716,705	549,166	23
Equipment:			
Steam locomotives	1,263,647	942,793	25
Freight-train cars	2,895,376	1,570,641	46
Passenger-train cars	399,780	264,357	34
Total road and equipment	*20,912,153*	*16,653,400*	*20*
General expenditures:			
Organization expenses	20,912	16,729	20
General officers and clerks	125,473	100,378	20
Law	62,736	50,190	20
Stationery and printing	20,912	16,730	20
Taxes	104,561	83,649	20
Interest during construction	1,215,737	972,590	20
Other expenditures—general	83,648	66,918	20

TABLE 2—PERCENTAGES OF ROAD AND EQUIPMENT TOTALS ALLOWED FOR GENERAL-EXPENDITURES ACCOUNTS

Organization expenses	0.1
General officers and clerks	0.6
Law	0.3
Stationery and printing	0.1
Taxes	0.5
Other expenditures—general	0.4
Total	2.0

DEPRECIATION OF PRIMARY ACCOUNTS

Coming now to the primary accounts, space does not permit their presentation in full, but some of them are given in Table 1. The depreciation percentages have been computed by this journal. Of the large road items it will be noted that the highest percentage deducted is from ties. Tracklaying and surfacing is diminished 23 per cent. Grading is reduced 0.17 per cent. No deduction is made from engineering, which, the engineering report states, was figured at various percentages from 2½ to 5. This allowance of 100 per cent for the service condition of engineering is in conformity with the views of the Engineering Board of the Division of Valuation, as set forth in the Engineering Record of June 17, page 794. Of the equipment accounts, freight-train cars sustain the heaviest deduction—46 per cent.

TABLE 3—REPRODUCTION FIGURES FOR CERTAIN PRIMARY ACCOUNTS, TEXAS MIDLAND RAILROAD

Class	Reproduction cost New	 Less depreciation	Depreciation deduction, per cent
Road:			
Engineering	$54,926	48,807	9
Grading	411,866	411,471	0.11
Bridges, trestles and culverts	387,792	289,461	25
Ties	272,688	136,345	50
Rails	525,134	434,205	21
Ballast	210,637	168,509	20
Tracklaying and surfacing	207,502	140,642	32
Equipment:			
Steam locomotives	187,928	107,643	43
Freight-train cars	190,432	120,423	37
Passenger-train cars	73,455	39,236	47
Total road and equipment	*3,183,360*	*2,370,648*	*26*
General expenditures:			
Organization expenses	831	831	0
General officers and clerks	15,000	15,000	0
Law	9,100	9,100	0
Stationery and printing	1,100	1,100	0
Taxes	5,971	4,478	25
Interest during construction	144,691	108,052	25

Considering the combined total of the road (exclusive of land) and equipment accounts, the depreciation deduction averages approximately 20 per cent, and this is the deduction made uniformly from the general-expenditures accounts. The reproduction-cost-new figures, with the exception of interest during construction, are, as the engineering report states, percentages of the total of the road and equipment accounts, exclusive of land. These percentages are as shown in Table 2, making a total of 2 per cent. The estimated depreciation of the terminal properties is less than for the main company, and the depreciation of general expenditures is correspondingly reduced.

INTEREST DURING CONSTRUCTION

Interest during construction was reckoned at 5 per cent per annum on all road and equipment accounts except land. Interest on the road accounts was figured for one-half the construction period, plus three months, of a particular section, it being considered essential to have the money on hand three months in advance of actual expenditure. The construction periods assigned vary from 1½ to 3 years, the maximum period being allowed for two sections only in mountain country where the work is heavy. Interest on the equipment accounts was reckoned at 5 per cent for a period of three months.

Land is figured on the basis of market

value of contiguous land, with no allowance for cost of acquisition, severance or continuity. The figures are kept separate from the reproduction cost totals, and are designated "present value of land."

As previously stated, nothing is allowed for "other values or elements of value." Neither is there separate mention of development expenses, appreciation of roadbed and track, contingencies or working capital, and apparently nothing is allowed for them.

The road accounts, general expenditures and land items are allocated to the two states, Georgia and Alabama, containing the properties. There is no allocation of equipment.

Texas Midland Railroad

Covering a road of only 111 miles, the Texas Midland report is much smaller. As already announced, the reproduction cost new and reproduction cost less depreciation are given as $3,382,004 and $2,527,417 respectively. Both figures exclude land, which is given a present value of $236,690. These figures compare with a capitalization of $2,112,000. Per mile the capitalization is $19,027, the estimated reproduction cost new, taking into account the report's figure for present value of land, is $32,601 and reproduction cost less depreciation $24,902.

TABLE 4—PERCENTAGE OF ROAD AND EQUIPMENT TOTALS ALLOWED FOR GENERAL-EXPENDITURES ACCOUNTS

Organization expenses	0.03
General officers and clerks	0.47
Law	0.29
Stationery and printing	0.03
Taxes	0.19
Other expenditures—general	0.00
Total	1.01

As to the primary accounts, the figures corresponding to those in Table 1 for the Atlanta, Birmingham & Atlantic are given. (They are exclusive of subsidiary properties valued at about $22,000.) It will be noted that depreciation is deducted from engineering, the engineering report explaining that the service condition for preliminary and location surveys and for construction of roadbed is assumed to be 100 per cent, the remaining expense being given a service condition per cent equal to the weighted service condition per cent of the remaining road accounts (exclusive of land). On the other hand no depreciation deduction is made from the figures for organization expenses, general officers and clerks, law or stationery and printing.

These figures, and that for taxes, were not determined by percentages of the road-and-equipment total, as was done on the Atlanta, Birmingham & Atlantic, but were estimated in each case. Nothing is accredited to other expenditures—general. The resulting percentages of this total, corresponding to Table 2, figure approximately as shown in Table 4, and total 1.01 per cent.

Interest during construction is figured on one-half the total expenditures for the total period of construction.

ORIGINAL COST

On the subject of original cost the report says:

"An attempt was made by the accountants of the commission to show as required by the statute the original cost to date of each piece of property in detail. For this purpose every voucher of the Texas Midland Railroad was examined and an attempt made to rewrite the investment account of that company according to present accounting rules of the commission. The result has not been satisfactory. It was possible to correct many errors, but there were also many instances in which the voucher could not be allocated with reasonable certainty. Great difficulty was experienced in determining what should be written out of the account by reason of retirements of worn-out and abandoned property. . . . It was possible to identify the equipment now in existence and show the cost of that, and also to show original cost of lands with reasonable certainty, but to attempt a statement of the original cost of particular structures, or by primary accounts or even of the property as a whole would be entirely misleading."

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

"Uniformity Coefficient" a Misnomer

SIR: As clearness and conciseness of definition are most desirable in engineering education, I want to call attention to a lack of both which exists in defining the "uniformity coefficient" of sand. The difficulty can be obviated to a large extent, it seems to me, by introducing a name for the larger size which is taken to determine this coefficient; that is to say, the size than which 60 per cent of the given sample is smaller and 40 per cent is larger. For some time, in referring to that size, I have used the term "uniformity size," which seems to me appropriate, as this size is only used for the purpose of determining the uniformity of a given sample. Having defined the uniformity size as above, and following the usual definition for effective size as being that size than which 10 per cent of the given sample is smaller and 90 per cent is larger, it is a simple matter to define the "uniformity coefficient" as the ratio between the uniformity size and the effective size.

I hope the above suggestion will attract the attention of those interested and produce some discussion of the subject.

HUGH MILLER,
Lecturer in Civil Engineering, Rice Institute.
Houston, Texas.

Belts for Floating Concrete Should Be Waterproof

SIR: Referring further to the use of belts for floating concrete pavements (see the Engineering Record of Oct. 14, page 481), I am convinced from the experience of several contractors during the past month that the best results are to be obtained from the use of rubber-coated belts, or with a belt that is at least well vulcanized so as to render it absolutely waterproof. An ordinary canvas belt not properly waterproofed is of no service, as it soon becomes saturated.

I am still inclined to believe that the 8-in. belt should be used for the first floating, and on a number of jobs have secured excellent results by the use of this same belt for the second floating, although it is necessary for convenience and economy of operation to have two belts on the job.

It takes some little time and considerable patience to break in a new belt, due to the fact that new belting is very stiff and has a tendency to scallop at the edges. This is particularly true of the wider and heavier belts.

I have found a number of contractors who were not securing the best results, due to the fact that they did not limber up the belt before using it and did not float at the proper time. With these matters straightened out I find no case where the belt had not been entirely satisfactory to all parties concerned.

H. B. BUSHNELL,
Division Engineer, Illinois State Highway Department.
Aurora, Ill.

A Sewer System Without Manholes or Records

SIR: Previous to 1915, at which time the commission-manager form of government went into power, the city of St. Augustine, Fla., had made only spasmodic efforts at retaining the services of a city engineer. It was customary to retain the services of an outside firm to do the engineering work, and the yearly average paid on such work would have nearly paid the salary of a good engineer. The results obtained by the city by this hit-and-miss method cannot be compared with the results if a permanent engineer is employed. The permanent engineer has time and opportunity to gather information, study conditions and work toward a general plan. Better permanent records will also be left.

When the writer accepted the position of city engineer of St. Augustine in October, 1915, he found that the storm sewers were not doing the work that should be expected of them. The water would stand over some of the catchbasins for nearly a day after a rain. There were only three manholes to be found on 6 miles of storm sewers, and the only plan to be found was one owned by the Florida East Coast Hotel Company, showing the approximate location of a number of services which that company had constructed, some as early as 1887.

The sewer grades must necessarily be very slight, for the ground is very flat and there is scarcely a place 10 ft. above mean sea level. Notwithstanding this very flat grade no attempt had ever been made to clean the sewers except occasionally to flush with a firehose, although a large percentage had been in the ground over 25 years.

Manhole and catchbasin castings and a sewer-cleaning machine were purchased and the work of constructing manholes for the purpose of cleaning the sewers was for the first time begun in December, 1915.

Much difficulty was experienced in most of the sections in running the rods through the sewers, and in nearly every case it was necessary to flush the sewer to aid the rods. All the sewers were found to have large quantities of dirt and occasionally large chunks of roots. One 12-in. sewer in a prominent street, close to the business and hotel district, was 95 per cent full of dirt.

In one instance two 12-in. and one 8-in. line emptied into a 10-in. trunk. This trunk, as well as some other sewers, had an up grade toward the outlet. In two other cases one 12-in. pipe formed the outlet for two 12-in. pipes, all on about the same grade.

The Valencia St. sewer was shown by the Florida East Coast Hotel Company plan to run through the railroad yards and empty into the San Sebastian River near the railroad bridge. A thorough search for the outlet revealed nothing until a foreman was found who had been around the yards for a number of years. He went to a point about 50 ft. back from the present shore line and said that the end of the pipe was under the place where he stood. The end of the pipe was found buried under rubbish 5 ft. deep.

The process of cleaning the sewers revealed obstructions in the pipe. In several cases pipes of various sizes crossed through the sewer. One 4-in. gas main crossed through the center of a 12-in. sewer.

One 6-in. lateral from a catchbasin extended 4 in. into the 8-in. main with which it connected. One obstruction was a sharp reverse curve made by two one-eighth bends. There was no apparent cause for this freak.

When the work of constructing manholes was begun there was adverse criticism, for it was considered useless expense. About 150 manholes have been constructed and most of the sewers have been cleaned. Now that the former critics have seen the results of the work they have changed opinions. As one expressed it, "Where it formerly required hours for the water to get away, it now requires only minutes. The sewers are as good as new at a fraction of the cost of constructing new sewers."

C. E. HENDERSON,
St. Augustine, Fla. City Engineer.

Speed Suppressors in Roads Needed to Curb Automobiles

SIR: The subject of fatalities resulting from automobile accidents is one that commands much attention in the mind of the public, and is being widely discussed throughout the country. The evil is fully appreciated, but no one has proposed a remedy.

The subject, in so far as it demands public concern, presents itself mainly in two aspects, (1) dangerous speeding in the streets of cities and towns, and (2) fatal collisions between automobiles and railroad trains or suburban trolley cars, where highways cross the tracks. The last named probably takes a much higher toll of human lives than speeding in city streets.

Experience has abundantly shown that laws enacted for the purpose of suppressing the evil cannot be made effective, as it is not practicable to enforce such laws. Since no efficient remedy is to be sought in the enactment of speed laws, the only remaining recourse is to apply physical control to moderate the speed of autos.

To abate or prevent the enormous death toll at railroad crossings due to lack of caution by auto drivers there is a simple, direct and efficient device that may readily be invoked for the purpose; to wit, on each side of the railroad track at highway crossings erect a "bumper," a ridge of earth or other road material, across the highway, generally outside the railroad right-of-way. This bumper should be steep enough to compel auto drivers to put on "slow speed" to climb over it, and its proportions adjusted after experimentation. Probably an elevation of 3 or 4 ft., with a grade of one on six, would serve the purpose.

This physical impediment would not only slow down the auto at this critical point, but would forcefully remind the occupants that they were in the presence of danger. The obstruction offered to ordinary horse-drawn traffic would not be serious, as sufficient extra effort could be put on for a short pull of say 20 ft.

Referring to speeding on city streets, there is no logical justification for building speedways capable of developing high speeds —30 or 40 or 50 miles an hour—in situations where considerations of public safety forbid such speeding. City governments take a pardonable pride in building long and smoothly surfaced streets, suitable for much higher speeds than is permissible, but to what practical end? Only to hold out invitations to high speeders, with a strong temptation to yield to the speeding impulse.

Here is presented an engineering problem for the consideration of those engineers who have control of street building and paving.

Throughout the domain of structural engineering the aim always is to build structures to serve certain purposes, and not to serve other and foreign or antagonistic purposes. Pursuing this principle in the building of streets in cities and towns, correct engineering practice would dictate that the streets should be so designed as to serve the purposes of street traffic, and not of speedways. In the variety of situations to be encountered streets should be so paved and surfaced as to permit without undue impediment fair degrees of speed up to the maximum as fixed by ordinance, and no higher.

The particular form and spacing of "speed suppressors" presents a problem that ought to be worked out by careful experimentation, the aim being to avoid undue disfiguration of streets, as well as undue hindrance to maintaining a uniform rate of speed within or up to the maximum allowed. This might take the form of graceful undulations along the axis of the street or of individual bumpers of proper design and spacing. T. G. DABNEY.

Clarksdale, Miss.

Durability of Concrete Roads

SIR: Concrete has established itself too firmly as a high-quality material for permanent road construction to be overthrown by biased testimony, but nevertheless the letter by D. T. Pierce in your issue of Oct. 21, page 509, strikes one as being about the extreme of partisanship deserving of accommodation in a technical journal.

Mr. Pierce is a dialectician of ability. On the correction of an editorial error as a peg he hangs a criticism on concrete as a road material and a praise on asphalt as another road material. He performs the trick so nicely that the editor could hardly fail being intrigued into publication. Ostensibly the illustrations of road defects are intended to reach no further than correction of a writer's error, if, considered broadly, error it was, but in reality they carry as far as a general condemnation of concrete roads. Because of this fact answer is demanded in defense of a road material so good that its opponents must resort to counting an occasional dropped stitch in order to find fault with the weave.

No type or form of permanent road construction has been developed of which examples of failure cannot be found. This is true of all engineering structures. Steel bridges have failed, masonry dams have been swept away, brick and concrete buildings have collapsed, steel railway rails have snapped and wrecked trains, locomotive boilers have exploded. Are these facts justification for condemning the materials and structures named? If not, then examples of concrete road defects merit the same judgment.

Any engineer and road builder knows that no type of road construction devised has recorded complete freedom from failures. Brick roads, bituminous roads, concrete roads, roads of any material can be found and photographed so as to present an appearance of dilapidation beside which the ruins of the Appian Way would appear smooth. This had been done with the concrete roads of Wayne county even before it was so carefully done by Mr. Pierce. Yet the fact remains that all but a minor fraction of the 150 miles of these roads remain excellent examples of the road builder's art. Even the destroyed fraction seems good enough, according to Mr. Pierce, to serve as a base for the bituminous surface which he indicates is preferable to a new concrete surface.

These things being as related, protest is justified against publication of a letter of the character of Mr. Pierce's in a professional paper without clear explanation of its limited value as evidence. We submit, sir, that you have a fault to remedy in the publication, without qualification, of the biased and misleading evidence presented by Mr. Pierce. A. CAMERON.

President, National Association of Mixer Manufacturers.

Chicago.

[Comment on this letter will be found in the editorial columns of this issue.—EDITOR.]

Manning vs. Kutter for Measuring Flow of Water

SIR: The writer would like to see discussed in your columns the relative merits of Manning's and Kutter's formulas for the velocity of flow through pipes and conduits. Manning's formula was published in the *Engineering News* of June 17, 1915, page 1171. This formula is:

$$V = \frac{1.486 \times r^{\frac{2}{3}} \times 5^{\frac{1}{2}}}{n}$$

where r is hydraulic radius; s, slope, and n, coefficient of roughness.

Malden, Mass. R. W. HORNE.

Industrial Accidents in Pennsylvania

According to the recent report of the commissioner of the Pennsylvania Department of Labor and Industry, John Price Jackson, 203 workmen have been killed on an average every month in Pennsylvania industrial plants during the current year. At the same time more than 20,000 others have been injured monthly. During the month of September injuries averaged 888 per day, and during the first nine months of the year a total of 188,278 industrial employees in Pennsylvania were injured while at work. This economic waste the report holds to be largely preventable.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Powerful Pipe Wrench Dismantles Large-Diameter Pipe Line

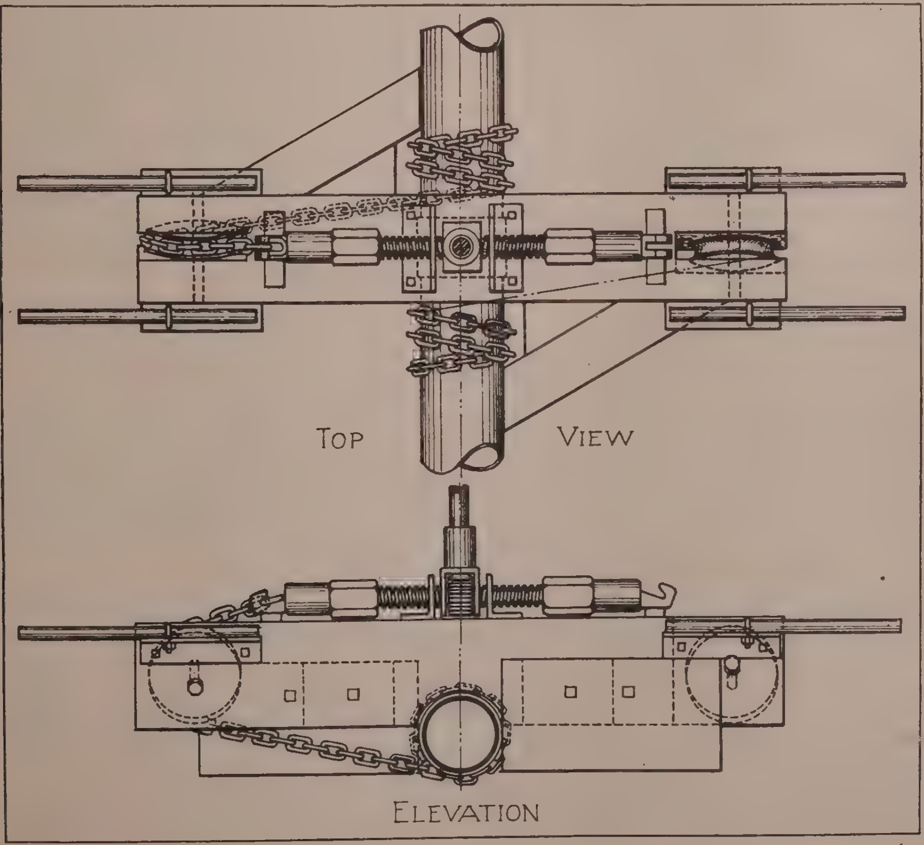
By JAMES RYAN and E. C. ENTLER
Keokuk, Iowa

IN REMOVING a line of about 4000 lin. ft. of 6 and 8-in. pipe with screwed joints which had been in place for about five years the pipe wrench shown in the illustration was used with great success to break the joints. It was rigged from a steamboat ratchet and a 12 x 12-in. timber 6 ft. long. With this rig it was possible for one man to start the joints on 8-in. pipe.

In operation the wrench was placed astride the pipe and centered over the coupling. Then the chains were given several turns around the pipe, carried over the sheaves at the ends of the wrench and hooked into the special hooks on ends of the ratchet, the screw at the start having a hold of a few turns in each sleeve. Then by means of the handle and ratchet the chain was quickly tightened up and the joint broken, in most cases with a jump. The sleeves on the outer ends of the ratchets were kept from turning over by the short pieces of steel shown on the bottom of the hooks. The short diagonal struts on each side of the 12-in. timber rested against the pipe and took the pull of the chains. The handle used in the ratchet was about 3 ft. long.

Two short pipe handles at each end provided means for carrying the wrench from place to place. For clearness the chain is shown on one-half of the sketch only, the other half being the same.

This rig could also be used for tightening joints in pipe laying by reversing the chains and the diagonal braces.

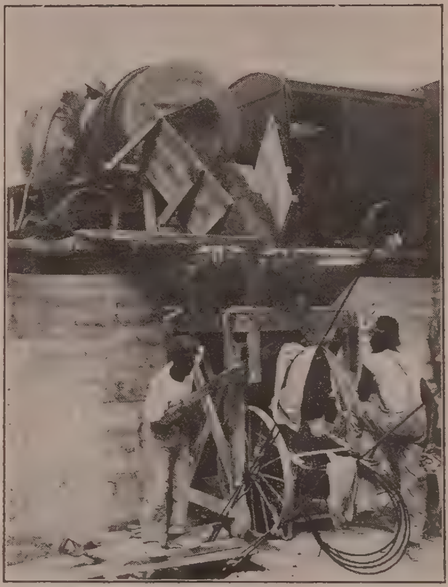


WRENCH BROKE OUT WITH EASE JOINTS OF 8-INCH PIPE LINE IN PLACE FIVE YEARS

Mixers Mounted on Street Wall Speed Up Foundation Work

MOUNTED portable mixers on the street foundations of a 200 x 287-ft. industrial warehouse in Chicago are used to expedite the foundation work and to supplement the output of three distributing towers. The Chicago Junction Railway Company is building a large general warehouse at Thirty-ninth and Canal streets, in the central manufacturing district, a rapidly developing manufacturing and mail-order merchandising center served by this railroad. This five-story building is of flat-slab, reinforced-concrete design, with red-face brick curtain walls and terra-cotta trim. The floors are designed for heavy loads, and railroad switches enter the center of the building on the first-floor level to afford shipping facilities.

As time was an important factor in the construction, C. A. Sawyer, Jr., manager for the contractor, the George A. Fuller Company, is using the same method he had employed on a Harvard University dormitory building, where the concrete had to be deposited over large floor areas. He found much economy by mounting portable mixers on the walls and moving them along as the work progressed. In the Chicago job two Standard mixers, one of 10-ft. capacity and the other of 16-ft., were mounted directly on the street foundation walls when the latter had been completed. All charging operations are carried on from the street level and in the street. The discharge is to a small steel storage hopper for filling the carts.

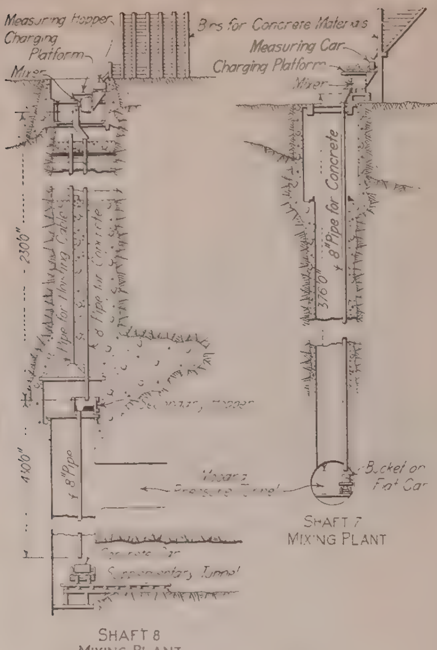


SMALL PORTABLE MIXER MOUNTED ON WALL SUPPLEMENTS TOWER PLANTS

Wet Concrete Successfully Dropped 660 Feet Into Tunnel Cars

IN LINING the supplementary tunnel at the west end of the siphon which carries New York City's new Catskill aqueduct under the Hudson River all of the concrete was dropped vertically through 8-in. open pipes down shafts 7 and 8, which furnished the only access to the work. The method, which was noted in the description of the work published in the Engineering Record of April 24, 1916, page 541, was developed by allowing the pipe to discharge directly into the tunnel cars, and used with success for the entire work. According to data made public in a paper presented by George J. F. Carey to the Municipal Engineers of the City of New York, strength tests of concrete samples taken at the mixer and in the tunnel below showed the concrete to be actually stronger after the drop than before.

As will be remembered from the article referred to, this supplementary tunnel was constructed by sinking a blind shaft, 7A, from the floor of the old tunnel about 380 ft. west of the old construction shaft 7, and driving, from the bottom of shaft 7A and from the side of old shaft 8, near the river bank, a supplementary tunnel some 400 ft. below the original tunnel. The work was



CONCRETE DROPPED 660 FEET TO CARS

undertaken after a preliminary test had developed weakness in the overlying rock near the river bank. Concrete for lining shaft 7A and for part of the invert in the new tunnel was shot down shaft 7 into round buckets on cars, in which it was transported west in the old tunnel to the new shaft. Concrete for lining most of the supplementary tunnel was shot down shaft 8 to the tunnel level, where it was discharged into concrete cars which carried it west in the new tunnel to the forms. After some experiments with a short chute at the bottom of shaft 7, it was found best to discharge the concrete directly into the cars or buckets. The concrete moved at such speed that a shower of sparks could be seen at the lower end of the pipe, and the buckets and cars rocked under the impact. The falling concrete, however, churned into the mass already in the bucket or car without the least objectionable splashing, although a moderately wet mixture was used. No free water was present after discharging and there was no separation of the aggregate. In fact, the drop appeared to improve the mixture.

At shaft 8 the concrete had to pass through a plug in the shaft above the level of the old tunnel and from there down to the level of the new tunnel. Just beneath this plug the upper 8-in. pipe discharged into a hopper from which a second pipe extended to the lower level. The bottom of the hopper was reinforced with several feet of scrap metal. Beside this protection, the falling concrete soon wore a hole which, as it was always filled with concrete, acted as a buffer.

Tests were made to determine the strength of the concrete before and after dropping at periods of 29, 31, 52 and 54 days for shaft 7 and of 21, 22, 30 and 32 days for shaft 8. In both cases the long tests showed the samples taken from the bottom of the pipe to be considerably stronger than those taken at the surface, while the short tests showed some of the surface samples to exceed in strength the samples taken in the tunnel. The average of the 52 and 54-day tests showed the tunnel sample to be 25 per cent stronger than samples taken from the same batches at the surface. While concrete has been placed before on the Catskill aqueduct work through pipes by discharging it directly into the mass of plugs and similar structures, it is believed that this is the first instance in which the method described was ever used successfully at such depth for discharging concrete into cars.

The work was carried out for the Board of Water Supply by the Oscar Daniels Company under the direction of its engineers, D. E. Baxter and C. L. Ostenfeldt, with S. A. Knowles as superintendent. The author of the paper mentioned, as field engineer, and W. B. Hoke as section engineer had charge of the work for the Board of Water Supply under Ralph N. Wheeler, department engineer; Alfred D. Flinn, deputy chief engineer, and J. Waldo Smith, chief engineer of the board.

Exact Distribution Kept in Form for Comparing Final Costs

By HOMER V. KNOUSE

Construction Engineer, Metropolitan Water District of Omaha

THE FORM shown herewith was devised by the writer to record labor distributions accurately in the field, and at the same time to make a record in convenient shape for direct use in compiling final costs. Folded along the dotted line and inserted in an aluminum sheet holder, this form is readily carried around in the pocket. It makes use of both sides of the sheet, and the way in which time is kept on it and the distribution totals arrived at is evident without further explanation. The sheets as they are filled up day by day are filed in a ring binder after being punched as shown along the long side when open.

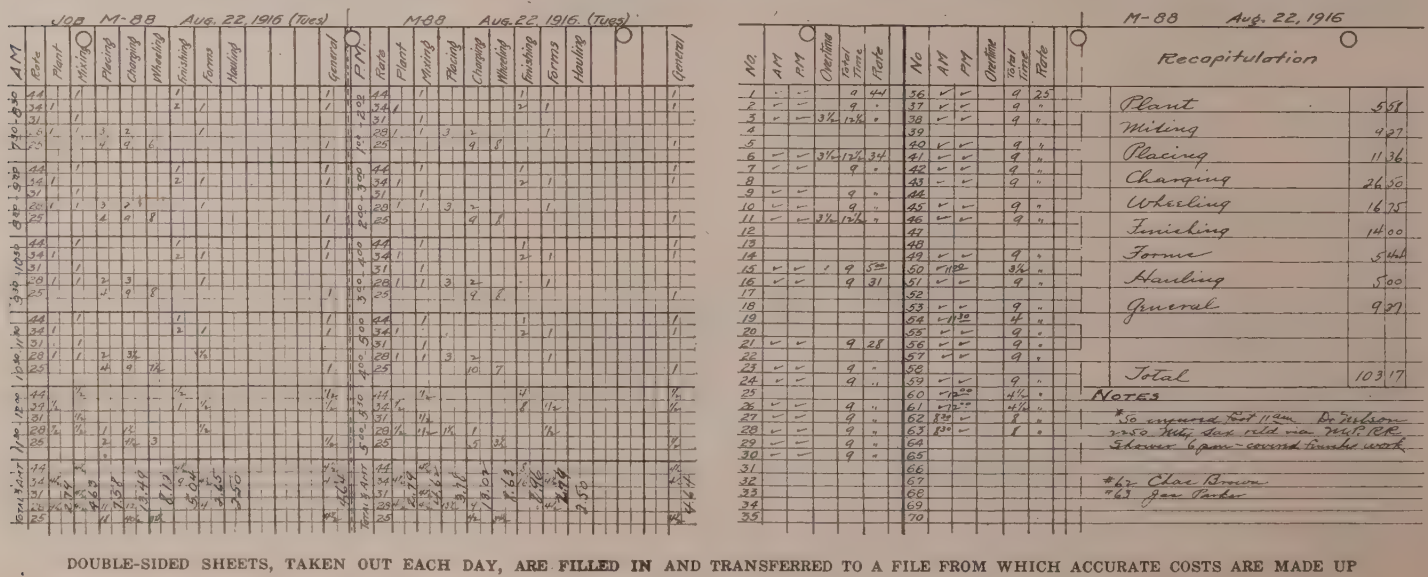
Asbestos Lining in Truck Body Holds Heat in Asphalt

IN two 7-ton trucks recently furnished the White Paving Company, Chicago, for hauling hot asphalt an insulated lining was built inside the regular steel body. These trucks, which are equipped with 6-cylinder 60-hp. electric starter engines, have the extra lining bolted to the regular body. The lining consists of a light sheet-steel, metal-lined plank frame, with asbestos sheets between the steel plates and the planks. For hauling stone, gravel, coal or other material in which it is not desired to retain the heat the lining can easily be detached as a whole.

The dump bodies of these trucks, which are made by the Stegeman Motor Truck Company, Milwaukee, are equipped with chutes to deliver on either side and a hydraulic hoist to operate the body to dump the material to the rear.

Shipyards Active and Export Records High in Northwest

In Seattle and vicinity three shipbuilding firms are at work on twenty-three steel vessels and two Portland firms are building eight more, making a total of thirty-one, the gross registered tonnage of which will be about 200,000 tons and total value, completely equipped, about $25,000,000. Wooden vessels are under construction as follows: Seattle, six; Portland, two; Aberdeen, four, and Astoria, three—the total value of the fifteen being about $1,600,000, exclusive of engines. Some of these will be driven by steam and some probably by Diesel engines. Announcement of final decision has not yet been made. According to a recently published summary by the Department of Commerce at Washington, D. C., Puget Sound ports surpassed all previous records in June, when their total foreign trade amounted to $43,812,200.


JOB M-88 Aug. 22, 1916 (Tues)
A.M.
Rate
Plant
Mixing
Placing
Charging
Wheeling
Finishing
Forms
Hauling
General
M88 Aug. 22, 1916 (Tues)
P.M.
No.
A.M.
P.M.
Overtime
Total Time
Rate

M-88 Aug. 22, 1916

Recapitulation

Plant	5	58
Mixing	4	27
Placing	11	36
Charging	26	50
Wheeling	16	75
Finishing	14	00
Forms	5	44
Hauling	5	00
General	9	37
Total	103	17

NOTES

*50 injured foot 11am Dr Nelson
2250 Mty Sax rild via M.P. RR
Shower 6pm – covered finished work

*62 Chas Brown
*63 Jas Parker

DOUBLE-SIDED SHEETS, TAKEN OUT EACH DAY, ARE FILLED IN AND TRANSFERRED TO A FILE FROM WHICH ACCURATE COSTS ARE MADE UP

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Let the Contractor Solve Disposal Problems

San Francisco Simply Asks for Bids, Leaving It to Bidders to Draft Plans and Name Guarantees

The question of garbage disposal in San Francisco has been before the board of supervisors of that city for more than a year. It has been discussed several times, the health committee has made recommendations, and proposals have been received from a large number of would-be garbage disposal companies, but nothing had been done up to Oct. 30 when the matter was on the supervisor's calendar as a special order.

When the subject came up at this session, instead of entering into a lengthy discussion of the best course to pursue, Supervisor McLaran moved that the city call for bids for the disposal of garbage, proposals to be received Nov. 20 accompanied by a certified check for $10,000. Each bidder is to furnish detailed plans which he proposes to use, and state fully the terms, conditions and guarantees attached thereto. After a short discussion this motion was adopted and official action was taken accordingly.

Eighteen Proposals Received

In a recent report issued by M. M. O'Shaughnessy, city engineer of San Francisco, eighteen propositions which had been tendered to the city were discussed in detail. This large number of offers would naturally be taken to indicate that there is a considerable interest in the profits that may accrue from the disposal of the city's garbage. The present situation which has developed from the refusal to accept the incinerator which was built under contract for the city has been covered in Engineering Record articles as follows: general description of the plant, Aug. 16, 1913; report of tests, July 4, 1914; discussion of design and operation, June 19, 1915; brief review of the situation, Feb. 20, 1915.

New Subway Link Opened November 5

The Ely Avenue extension of the Queensboro subway, from the Hunter's Point Avenue station in Queens north to the new Queensboro Bridge plaza station, New York City, was opened to the public Nov. 5 at noon, completing the first through rapid-transit link between the new half-million dollar station on the Queensboro Bridge plaza and Park Avenue and Forty-second Street, Manhattan.

The Queensboro subway is an important link in the new dual rapid-transit system. Ultimately it will be extended west from Park Avenue to Times Square. At the bridge plaza station in Queens it connects with the Astoria and Corona elevated extensions, which are now being pushed to completion and should be in operation within the next few months.

Concrete Institute Convenes February 8, 9 and 10 at Chicago

The thirteenth annual convention of the American Concrete Institute will be held Feb. 8, 9 and 10 at Chicago. The fourteen technical committees of the institute are actively at work in their respective fields and will report at the February gathering. Funds are now available for publishing all back issues of the proceedings, and the material is in the final stage of editing. Volumes 9 and 10 will be issued this year, and Volume 12, which is a record of last February's convention, is now being bound.

Water Meter Rate Decision Pending in San Francisco

About four months ago the Spring Valley Water Company of San Francisco decided that in order to trace unnecessary waste it would be advisable to meter a large portion of the city service. Accordingly, about 12,000 meters were installed throughout the city. The meters have increased consumers' bills in certain cases and there have been protests to the Railroad Commission of California. In an order dated Nov. 2 the Railroad Commission instructs the company that "while metered service under proper rates is undoubtedly desired, the commission believes it is neither fair nor proper that the Spring Valley company should begin charging under meter rates until the consumer has had an opportunity to adjust himself to the new situation and the commission to pass upon the fairness of the meter rates."

The commission directs the company to charge consumers according to the flat rates heretofore in effect, and not according to meter rates, until Feb. 1, 1917.

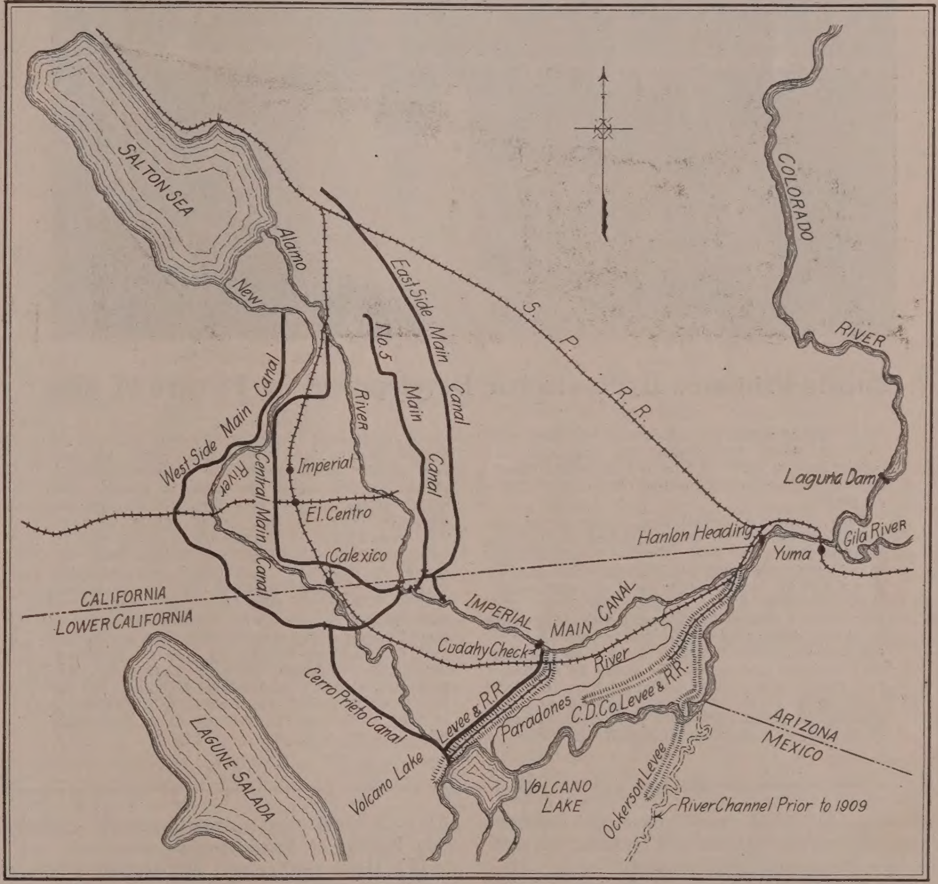
Reopen Long Sault Water-Power Case

The U. S. Supreme Court Oct. 31 heard reargument of the fate of a water-power project at Long Sault Islands in the St. Lawrence River, said to be capable of developing 600,000 hp. The Long Sault company's charter was annulled in Governor Sulzer's administration. The case was lost in the federal courts, and was brought to the Supreme Court, where the first argument was heard last April without a decision being reached.

What Imperial Valley Canals Need

Report of Board of Consulting Engineers Discusses Nine Improvements—Total Cost to Be $750,000

As a result of the detailed examination of the Imperial Valley canal system, the consulting engineers, C. E. Grunsky and George G. Anderson, have submitted a report recommending that work be undertaken at once on improvements which will cost about $750,000. The problem of greatest urgency is that of securing an adequate supply of water for the district during 1917. The proposed method of providing this is expected to obviate the difficulties under which the main trunk canals are now operated. The recommendations do not require the construction of a temporary dam across the river next year nor will the work be wasted in case it should, at some later date, be desirable to connect the Imperial Valley system with a supply from Laguna dam.



GENERAL MAP OF IMPERIAL VALLEY DISTRICT SHOWS LOCATION OF CANALS, DAMS AND RIVERS

Conditions affecting the water supply are at present considered more adverse than ever before. The deposits of silt in the upper portion of the main canal are very heavy. There are larger volumes of water with probably more silt in the Colorado River than is usual at this time of the year, and the natural erosion of the canal bed ordinarily experienced in the low-water season is probably less than normal.

It is not probable that the works proposed for reducing the amount of silt entering the canal can be constructed before the season when the demand for water usually cannot be fully met owing to silt deposits in the head of the canal. Because of these facts, the probability that permission to temporarily dam the Colorado River will not be renewed, and in view of the naturally increasing demand for water, amelioration of the water supply situation after high water next year can best be secured by centering effort on the reduction of canal bed elevations, beginning at the point of diversion from the river.

Recommendations

The recommendations for accomplishing this are discussed under eight heads as follows:

(1) Extend the canal upstream from Hanlon Headgate about 1¼ miles and there control the intake by a structure arranged to admit the river water over the top of flashboards. This is to reduce the amount of sediment entering the canal by increasing the width of intake and to afford a length of canal above the headgate from which the sediment can be removed readily by a dredge of large capacity.

(2) Dredge material from the canal bed in its upper reaches to the limit of dredger capacity, particularly between the Hanlon Headgate and the railroad bridge. There may be early need for two new suction dredges—certainly for one to be placed immediately in this part of the canal.

(3) Remove the trestle obstruction now in the canal about 3½ miles below Hanlon Headgate at the railroad and highway crossing. The trestles should be replaced by structures that will not cause the deposit of material above and below.

(4) Shorten the Alamo River canal above the Cudahy check by cutting off bends wherever a material reduction in length can thereby be effected. The several reductions in channel length which are feasible will cause a lowering of the canal bed at upstream points and this will in a short time make itself felt at the head of the canal where it will ultimately amount to 4 or 6 ft.

(5) Improve the regimen of the Alamo River canal by contracting its width at the points where bank erosion has occurred and the adjacent channel has widened and created broad sand bars with shallow depth. There are stretches, totaling several miles in length, where the channel is wide and flat, reducing velocity and inducing deposits. The effect of this repair will be to increase the scouring velocity and maintain a nearly uniform section.

(6) Make all necessary repairs at Hanlon Headgate. It is believed that there has been some undercutting of the concrete foundations and it is known that the granite on which the gate structures rest is not solid throughout. Although there has been no recent change in the situation every precaution should be taken to thoroughly safeguard the structure.

(7) If topographic conditions permit, connect the old Alamo River with the Alamo River canal so that this old channel may supplement the present canal to the extent of its capacity. Also, if conditions warrant, provide a wasteway leading to Paradones River.

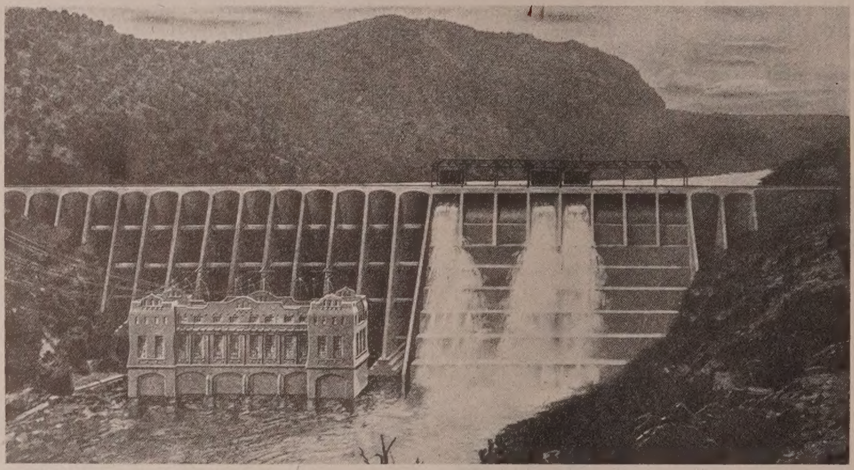
(8) Make studies and prepare the plans for upstream extension of the Cerro Prieto canal to a connection with the Alamo River canal at the Cudahy check. An early decision on this improvement must be made because the extension would afford opportunity to waste water from the Alamo canal aiding in the scouring of the main canal; it would relieve the burden upon that canal below the Cudahy check; it would provide economical service to the west side canal system, and when its north levee is brought to full contemplated height, would afford additional protection against floods from the south.

Conclusion

Particular attention is called to the fact that the bed of the Alamo River canal for more than a mile below the Hanlon Headgate now has an average elevation higher than the original sill of the gate. Recommendations 2, 3 and 4 are made for the primary purpose of lowering this average canal level before July, 1917.

A dredger of the suction type should be put to work immediately between Hanlon Heading and the railroad crossing. All sand that can be excavated here before next July will not only help directly in improving the water supply situation for 1917, but the cost of removing heavy silt by the larger dredger will be less than in the lower reaches of the canal by more expensive methods. The rehabilitation of the dredger Delta, of the long-boom, clamshell type, is recommended.

The early execution of the foregoing recommendations is expected to preclude the likelihood of any water shortage in 1917 and the engineers recommended that the $750,000 necessary to carry out the work be made available as soon as possible. The report was read Oct. 25 at a meeting in El Centro. It was generally believed that the directors of the district will at once take steps to raise the needed funds.



Paints Proposed Hydroelectric Development on Picture of Site

To show his clients how their project will look when completed, an engineer recently had a view of the hydroelectric development painted on a picture of the power site as shown.

The proposed installation is to be at the mouth of the White Rock Cañon of the Rio Grande River in New Mexico. As no rock was found, although the borings were carried down 186 ft. below river level, it was necessary to design a light, hollow structure supported on a mattress. A cutoff wall, consisting of sheet piling, and a solid concrete wall 15 ft. thick form a seal between the toe of the dam and the clay strata located about 50 ft. below the river level. The buttresses in the dam vary from 48 to 16 in. in thickness and are spaced 25 ft. on centers. The deck consists of a series of shallow arches 54 in. thick at the bottom and 16 in. at the top. The total height of the dam, measuring from the bottom of the mattress at the deepest point to the bridge on top of the dam, is 155 ft.; the width of the base of the dam, 200 ft. and the distance between the cañon walls, 400 ft. The dam therefore stands on a girder 400 ft. long and 200 ft. deep, which has been designed to carry the horizontal pressures due to the water and the cutoff over on the cañon walls. The power house has been designed in the Spanish mission style which prevails in New Mexico. The project will cost $2,200,000 and will develop 25,000 hp. A. G. Hillberg, consulting engineer, of New York City, designed the plant, which will be built by the Rio Grande Light, Heat & Power Company, of which Charles G. Wilfong of Philadelphia is president.

Road Builders Elect Officers

The following officers were elected Nov. 3 by the American Road Builders' Association at the meeting in the Automobile Club of America, New York City: President, Arthur W. Dean, chief engineer, Massachusetts Highway Commission; vice-presidents, W. H. Connell, chief of Bureau of Highways of Philadelphia; Austin B. Fletcher, state highway engineer of California, and Arthur H. Blanchard, professor of highway engineering, Columbia University; secretary, E. L. Powers, editor of *Good Roads;* treasurer, W. W. Crosby, consulting engineer, of Baltimore, Md. The directors elected are: T. R. Agg, professor of highway engineering Iowa State College; W. E. Atkinson, state highway engineer of Louisiana; Fred E. Ellis, manager, Essex Trap Rock & Construction Company, Peabody, Mass.; R. H. Gillespie, chief engineer of sewers and highways, Borough of the Bronx, New York City; B. Michaud, deputy minister, department of roads, Province of Quebec, Canada; Paul D. Sargent, chief engineer, Maine highway commission.

State Control of Power Suggested at Pennsylvania Conference

A committee to draft legislation in collaboration with the Pennsylvania Water Supply Commission was authorized at the recent conference on flood control and water conservation at Harrisburg. The committee will prepare bills for regulation of the control of state waters and report to another conference to be held before the next Legislature meets.

Provisions for flood prevention, impounding of waters to furnish a regular supply and state control of water power were urged by Governor Brumbaugh. Among those who took part in the discussion were Morris Knowles, consulting engineer and member of the Pittsburgh Flood Commission; Col. Edgar Jadwin, Corps of Engineers, U. S. A.; Frank Sutton, of the U. S. Geological Survey; Forestry Commissioner Conklin, and R. A. Zentmyer, water supply commissioner.

Welfare and Efficiency Conference November 21 at Harrisburg, Pa.

The fourth annual Welfare and Efficiency Conference to be held Nov. 21, 22 and 23 at Harrisburg, Pa., under the direction of the State Department of Labor and Industry and the Engineers Society of Pennsylvania will constitute a symposium of interest to manufacturers and the engineering profession. Dr. John Price Jackson, former dean of the engineering department of Pennsylvania State College and now commissioner of labor and industry in Pennsylvania, will preside.

Among the engineers who will speak will be William D. S. Ainey, chairman of the Pennsylvania Public Service Commission; R. Boone Abbott, president of the Engineers' Society of Pennsylvania and superintendent of the Harrisburg division of the Philadelphia & Reading Railway; Francis D. Patterson, chief of the division of hygiene and engineering of the department of labor and industry, and L. A. DeBlois, of the engineering department of E. I. du Pont de Nemours & Company.

May Cut Seattle Bridges to Permit Passage of Dredges

Lieut.-Col. J. B. Cavanaugh, Corps of Engineers, U. S. A., at Seattle, has served notice on A. H. Dimock, city engineer, that government dredges will pass through the Lake Washington Canal and through the Latona and Stone Way bridges between Nov. 7 and 10. Mr. Dimock in turn has referred the matter to the city council, which will be forced to devise means for caring for vehicular and street-railway traffic now passing over these bridges. As there are no drawspans in either structure, it will be necessary to cut them, suspending traffic entirely.

Engineering Society Activities

Canadian Society of Civil Engineers held its monthly meeting Nov. 2, at which G. L. Dobbin, of the Royal Montreal Regiment, delivered an address on "Bombing in the Front Line Trenches." Specimens of bombs were exhibited and their uses explained.

Western Society of Engineers will hold a meeting Nov. 13 at Chicago. C. J. Humphrey will discuss decay in timber and its growing importance to the engineer and architect. At the Nov. 20 session the importance of the relation of solid surface and liquid films in some types of engineering construction will be emphasized by Clifford Richardson. The construction of a narrow-gage railroad was Aaron S. Zinn's subject for his lecture at the Nov. 6 meeting.

Seattle Association of members of American Society of Civil Engineers held a meeting in the chamber of commerce rooms Nov. 1 to further discuss the proposed state water code and make recommendations in regard thereto.

Engineers' Club of San Francisco held its annual meeting and dinner Oct. 27. A paper on "Curtis Turbines Applied to Cargo Boats" and illustrated with stereoptican views was presented by W. J. Davis, Jr. The officers elected for the ensuing year were: President, C. T. Hutchinson; vice-president, William H. Shockley; second vice-president, B. P. Legare; treasurer, A. H. Griswold, and secretary, C. E. Grunsky, Jr.

Brooklyn Engineers' Club will meet Nov. 16 to hear Augustus J. Koehler, attorney, outline the history of the lien law and rights and remedies of engineers thereunder. At last Thursday's meeting Walter E. Heibel presented a paper on air conditioning in industrial plants.

Civil Engineers' Society of St. Paul will meet next Monday evening in the City Hall. George L. Nason will read a paper on landscape engineering.

American Society of Civil Engineers, at the Nov. 15 meeting in New York City, will discuss a paper on "The Yale Bowl" by Charles A. Ferry, consulting engineer, of New Haven.

New Chapter of Engineering Society at Gary, Indiana

Nine members of the American Association of Engineers recently conducted a meeting at the Y. M. C. A. Building, Gary, Ind., which was attended by thirty-seven engineers not identified with the movement and by three members at present employed in that city. After the objects, methods and results secured by the association during its sixteen months of existence were explained, twenty-one applications for membership were received and the temporary organization of the Gary chapter was effected. This is the first instance of the association succeeding in organizing a chapter during one evening's effort. The total membership is now 1335. When it reaches 1500 the initiation fee will be increased to $4.

What Engineers and Contractors Are Doing

Elmer Folsom and Milo C. Taylor have opened consulting engineering offices in the Peoples Bank Building, Bloomington, Ill.

Edward A. Clark, consulting engineer, of New York City, has withdrawn from the firm of Giles & Clark. He will continue as consulting engineer and contractor for diamond drill and wash borings.

Edgar F. Robinson has been promoted from chief engineer of the Buffalo, Rochester & Pittsburgh Railway to become general manager. Those formerly reporting to the chief engineer will hereafter report to the general manager. Mr. Robinson has been chief engineer since 1907 and has served the Buffalo, Rochester & Pittsburgh since 1902, when he was appointed engineer of track. After graduation from Rose Polytechnic Institute in 1894 he entered the service of the Cleveland, Cincinnati, Chicago & St. Louis Railway. From then until his appointment with the Buffalo, Rochester & Pittsburgh he was, at various times, employed by the engineering departments of the Indiana & Illinois Southern, the New York Central, the Chicago, St. Paul, Minneapolis & Omaha and the Butte, Anaconda & Pacific railways.

Richard E. Froiseth, formerly engineer for the Pittsburgh-Idaho Hydraulic Manufacturing Company of Boise, Idaho, has become associated with R. W. Rea, consulting engineer, of Portland, Ore. Mr. Froiseth received his engineering education from the International Correspondence Schools. In 1906 he joined the engineering staff of the Nevada Consolidated Copper Company. Two years later, after a brief experience with the U. S. Coast and Geodetic Survey, he went to the Utah Independent Telephone Company. While in that firm's employ he had charge of the construction of the Salt Lake City underground and overhead cable systems. In 1912 Mr. Froiseth joined the engineering staff of the Kittitas Reclamation District and later in that year went to the Kettle Valley Railway. That was followed, in 1913, by his appointment as assistant engineer for the Cascade Irrigation District in Washington. His appointment with the Pittsburgh-Idaho Hydraulic Manufacturing Company came soon after.

Carl J. Rhodin, formerly civil and hydraulic engineer on the San Francisco staff of the J. G. White Engineering Corporation, has resigned to open consulting offices in the Alaska Commercial Building, San Francisco. Mr. Rhodin is a graduate of the Royal Technical University of Stockholm, Sweden, class of 1900. A few months as assistant engineer in the department of public works of Gothenburg, Sweden, was followed by his appointment as assistant engineer to the chief of the Upper North District, Royal Department of Roads and Canals. After coming to the United States in 1902, Mr. Rhodin entered the employ of Snare & Triest, New York City, but resigned a few months later to become assistant engineer for C. MacDonald & Company on pier and foundation construction on the Thebes bridge across the Mississippi River. He went west in 1904 to take a position with the Atlantic, Gulf & Pacific Company, in charge of bids, estimates, plans and design of bridges, dredging machinery, foundations and wharves. For a few months in 1906 he was in charge of construction for the Pacific Gas & Electric Company, following which he was engineer of design and construction on several large buildings in San Francisco. Early in 1907 Mr. Rhodin joined the engineering staff of the California highway department, but resigned the next year to engage in private practice, which he carried on until 1910. He then became engineer on investigations for hydraulic projects for the Southern Pacific Company. Since March, 1911, he has been in the San Francisco office of the J. G. White company.

F. T. Cummings has formed a partnership with L. C. Bishop, county engineer of Converse County, Wyoming, to engage in consulting practice at Douglas, Wyo. Since late in 1910 Mr. Cummings has been engineer for the Rock Creek (Wyo.) Conservation Company and will continue to act as the firm's consulting engineer on its 80,000-acre irrigation project in the southern part of the state. For ten years previous to 1910 Mr. Cummings was employed in the maintenance-of-way department of the Union Pacific Railroad, attaining the position of assistant engineer at the time of his resignation.

A. P. Wyman has resigned as assistant engineer for the Maine Central Railroad to become civil engineer for the Texas Steamship Company at Bath, Me. Mr. Wyman had been in the employ of the engineering department of the Maine Central since graduation from the University of Maine in 1907.

C. J. Ullrich, assistant state engineer of Utah, has just finished a trip of investigation of water filings in various counties. Owing to the lack of railroad facilities he went by motor car, covering 1000 miles.

L. B. Stephenson has been appointed county highway engineer at Spirit Lake, Iowa, to succeed C. S. Arthur, resigned.

Obituary Notes

John F. O'Connor, formerly a government contractor and builder of the jetty system at Galveston, Tex., died in Chicago, Nov. 3, at the age of seventy-two.

George P. Woodhall, civil and mining engineer for the Utah Copper Company, was killed Oct. 30 at Bingham when a surveyor's tape he held came in contact with a high-tension wire. He was a graduate of the Missouri School of Mines, class of 1901. From 1906 to 1911 he had been assistant engineer for the Oregon Short Line and during 1913 and 1914 served as assistant state engineer of Colorado.

William Cooper Cuntz, general manager and director of the Goldschmidt Thermit Company of New York City, died Nov. 2 at Auburndale, Mass. Mr. Kuntz was born at Hoboken, N. J., in 1871. He attended the Hoboken Academy and Stevens Institute of Technology, being graduated from the latter institution in 1892. He then became connected with the Pennsylvania Steel Company's bridge and construction department and later with the sales department, which he represented in Boston, Philadelphia, London and other large cities. In 1910 he severed his connection with the Pennsylvania Steel Company to become a director and general manager of the Goldschmidt Thermit Company. At the time of his death he was also director in the Goldschmidt Detinning Company.

Sydney W. Hoag, who retired from the service of New York City about two years ago, and who had since carried on a consulting practice in that city, died Nov. 3. He had been in the city's employ for 30 years, entering the park department after graduation from the College of the City of New York. After a short term in the park division, Mr. Hoag was transferred to the Department of Docks and Ferries, in which he was made assistant engineer. He was promoted to deputy chief engineer of the department in 1905, from which position he retired with a pension a few years ago. Since retirement Mr. Hoag had engaged in consulting practice. He was a native of New York City and was born in 1858.

Barrel Elevator Installed Without Deep Pit

A barrel elevator which eliminates the need of a deep pit under the foot sprockets, and is therefore particularly adapted to conditions where the entire machine must be above the floor, has been designed by the Chain Belt Company of Milwaukee. The device has been adopted by the Standard Oil Company's Milwaukee works.

The machine is used to elevate empty barrels from the wash-house and deliver them upon an inclined skid, on which they roll by gravity about 100 ft. to the filling room. This barrel elevator has the special feature of being able to pick up the barrels from a curved chute underneath the foot sprocket.

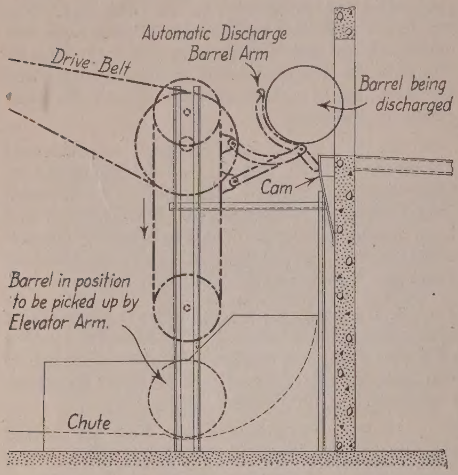
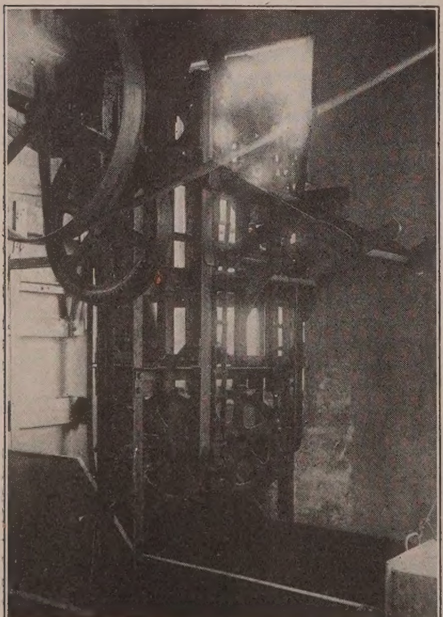

Automatic Discharge Barrel Arm
Drive Belt
Barrel being discharged
Cam
Barrel in position to be picked up by Elevator Arm.
Chute

DIAGRAM SHOWS ELEVATOR IN RELATION TO SKIDS, WITH ARM IN DISCHARGING POSITION

The barrels are rolled out of the tank and are picked up by the arm, one at a time, as it sweeps around the bottom of the chute. The barrel arm is attached to two strands of Griplock Chain Belt, which carry it around the head and foot sprocket. The arm is of the automatic-discharge type, which trips by means of a pair of cams engaging the ends of the curved lever arms which carry the barrels. These cams are placed on the upcoming side of the elevator, just in the opening in the wall through which it is desired to discharge the barrels. The Chain Belt is provided with suitable attachments for the crossbars of the barrel arm, and the whole machine is mounted on a structural-steel frame with necessary guides for the Chain Belt and supports for the shafting.



NEW BARREL ELEVATOR

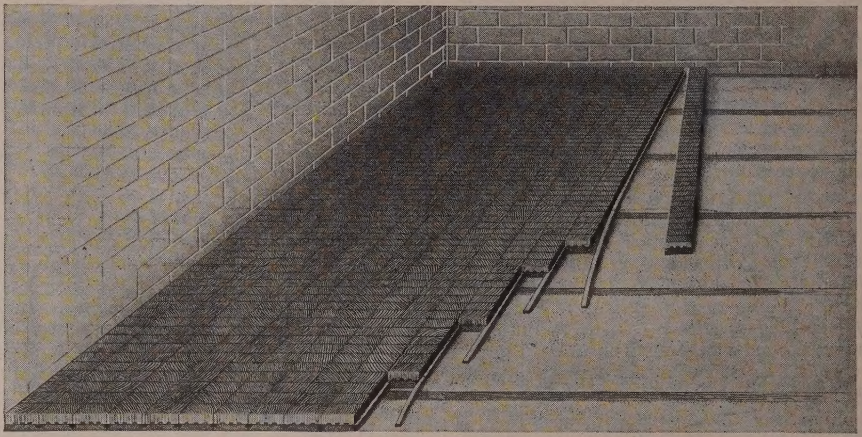
About 1 hp. is required for driving the elevator. The power is taken from a line shaft in the building by a belt coupled up to the elevator countershaft. The machine, which can be adapted to almost any conditions where it is desired to transfer barrels from one building to another, has a capacity of 120 bbl. per hour.

Make Smokestack 55 Feet Long in One Piece

A smokestack 50 ft. long was recently made in one piece for the city of Chicago by the Standard Spiral Pipe Works of that city. A piece of Standard reinforced spiral pipe was used. Later the Standard company made two one-piece 20-in. stacks 55 ft. long, using only one set of guy wires. A recent windstorm furnished a severe test which the Standard smokestack is said to have survived admirably.

Makes Floors of Wood Blocks Dovetailed to Base

The "welding" of wood blocks on end to the face of baseboards so that no other base is required (thus saving the tedious and expensive laying of single blocks) and making possible its use over timber joist are the features of a new type of flooring for use in mill buildings, factories, warehouses, station platforms, freight houses, bridges and docks. The illustration shows the construction—wood blocks dovetailed to a baseboard with a spline nailed to the floor joist or nailing strip to hold the 8-ft. sections together. The standard sections are made from Southern pine blocks 1½ x 3½ in. on the surface and 1 to 2 in. deep. The baseboard is 1 or 2 in. deep.



LAID ON CONCRETE, THE NAILING STRIPS FOR BLOXONEND ARE SPACED FAR APART

Sections of the flooring laid two years ago in front of the elevators in the Emery, Bird, Thayer Dry Goods Company's store in Kansas City are said to have given good service.

Bloxonend, as the new type is called, is made by the C. J. Carter Lumber Company, Kansas City.

Take Turns Driving and Sleeping to Deliver Trucks on Time

Facing a critical blockade in freight shipments due to the threatened railroad strike, the Norton Grinding Company of Worcester, Mass., prepared to meet the crisis by purchasing a fleet of three 5-ton White motor trucks, which was done through the White Company's Worcester representative. It was stipulated that the trucks were to be delivered in Worcester within three days, independent of railroad service.

Simultaneously with the signing of the contract a crew of six men in charge of a foreman from the Boston office was dispatched to Buffalo to meet the boat bringing the machines and to drive them from Buffalo to Worcester. A prearranged schedule called for the departure of the trucks from Buffalo on Sunday noon and their arrival in Worcester at the same hour on Tuesday. The trip was made in exactly 48 hours, which, so far as is known, is a record for continuous running for trucks of this capacity. Records showed that all three trucks made better than 11 miles to a gallon of gasoline on the 500-mile trip. Stops were made only to replenish the gasoline and oil supply and permit the drivers to eat. The army bodies with which the trucks were equipped were filled with hay and the drivers took turns at sleeping and driving.

Trade Publications

The following companies have recently issued trade literature:

United Brass Manufacturing Company, Cleveland, Ohio. Catalog D1, 72 pages, illustrated. Compiled especially for engineers and contractors interested in water works design and construction. Contains tables giving proportionate delivery of pipes from ⅛ to 10 in. diameter and other data.

Sprague Electric Works of the General Electric Company, New York City. Bulletin 48906, 8 x 11 in., 32 pages. Gives ratings, weights and specifications for electric hoists of one-half ton and one-ton capacity. Also shows many uses of that equipment.

Warren Webster & Company, Camden, N. J. Catalog, 8 x 10 in., 144 pages, illustrated. Enumerates advantages and describes design and installation of Webster vacuum system of steam heating. A typical system is described and illustrated, and the specific features of the Webster system are discussed. Special Webster heating systems and appliances also are illustrated and described.

William B. Scaife & Sons Company, Pittsburgh. Booklet, 8 x 11 in.; 72 pages. An illustrated treatise on the purification of water by means of the Scaife and We-Fu-Go systems.

The American Steel & Wire Company has issued a 150-page manual, illustrated, dealing with the treatment of water by the sulphate of iron and lime process. The book has been prepared by the company's water purification bureau, organized to exploit the use of sulphate of iron at filter plants. It is replete with useful data for sanitary engineers and city officials. There is a thorough discussion of the chemical phases of water purification in addition to many tables of discharge through orifices, heads and pressure equivalents, alkalinity and hardness equivalents and conversion charts. On filter operation a great deal of valuable information is given. Some of the subjects are coagulation, air wash troubles, strainers and manifolds, rate controllers and chemical difficulties. The book gives evidence of painstaking and intelligent preparation and should be in the library of every engineer or municipal official who has anything to do with the water supply of his city.